

Chapter 7

TECHNICAL SPECIFICATION FOR STORM SYSTEMS

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Chapter 7

TECHNICAL SPECIFICATIONS FOR STORM SYSTEMS

7.01 General Provisions

The specifications contained in this chapter, together with Oregon Department of Environmental Quality and U.S. Environmental Protection Agency standards and any other applicable requirements of the District and City, shall govern the character and quality of material, equipment, installation and construction procedures for gravity flow portions of public storm systems.

7.02 Manholes and Structures

7.02.1 Materials

- a. Aggregate and Portland Cement. Aggregate and Portland Cement shall meet the standards set forth in APWA 1990 Standard Specifications and Drawings Manual, Sections 212.2.02 and 212.2.03 respectively.
- b. Concrete. Concrete shall conform to the requirement of ASTM C, Alternate 2. Compressive field strength for manhole bases and miscellaneous concrete structures shall be not less than 3,000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches. Slump shall be between two and four inches.
- c. Manhole Frames and Covers. Casting shall be tough, close-grained gray iron, smooth and clean, free from blisters, blowholes, and all defects, and conform to ASTM A48, Class 30. To ensure flat, true surfaces, all bearing surfaces shall be planed or ground. Covers shall be true and set within ring at all points. Frames and covers shall be standard or suburban, solid, 16-hole or slotted depending on the type and location of the manhole and as approved by the District or City. Tamper proof frames and covers shall be used on all pipe systems of 24-inches and larger.
- d. Precast Manholes. Materials shall conform to the requirements of ASTM C478. Minimum wall thickness shall be five inches. Cones shall have the same wall thickness and reinforcement as riser sections. Joints shall be tongue and groove, rubber ring or keylock type. Cones shall be eccentric.
- e. Precast Bases. At the option of the Contractor, precast base sections or manhole bases may be used provided all the details of construction are approved prior to construction.

- f. **Pipe Stubouts for Future Connections.** Pipe stubouts shall be the same type as approved for use in the lateral, main, or trunk lines. Strength classifications shall be the same class as in adjacent trenches. Where two different classes of pipe exist at a manhole, the higher strength pipe will govern strength classification. The District or City may require the length of the stubout to be as long as it is deep. Knockouts may be used with District or City approval.
- g. **Preformed Plastic Gaskets.** Gaskets shall be Kent-seal No. 2 or Ram Neck conforming to federal specifications SS-S-00210 or approved equal.
- h. **Manhole Steps.** Materials shall be 3/4-inch galvanized Grade 40, ASTM A-123/A-615 or plastic with reinforcing bar, a minimum 1/2" Grade 60, meeting requirements of ASTM A615 encapsulated with injection molded copolymer polypropylene with serrated surfaces.
- i. **Structure Marker.** Posts shall be treated a minimum of 8 feet in length, and shall be treated 4" x 4", or 2" galvanized steel or as approved by District.

7.02.2 Workmanship on Manholes

- a. **Foundation Stabilization.** If, in the opinion of the District or City, unstable material exists that will not support the manhole or other structure, the Contractor shall install geotextile fabric or excavate below grade and backfill with foundation stabilization material.
- b. **Pipe Connections.** All rigid pipes, except ductile iron and reinforced concrete entering or leaving a manhole shall be provided with flexible joints within one foot of the manhole structure and shall be placed on firmly compacted bedding. All flexible pipe shall be connected to manholes by using PVC sanded bell adapter, kornseal boots, or solvent cement and clean sand application according to the manufacturer's recommendations. Aluminum pipe connections to manholes shall be wrapped where they will be in contact with concrete.
- c. **Flexible Joints.** Where the last joint of the line laid up to a manhole is more than one foot from the manhole base on pipes smaller than 24-inches, a six-inch concrete encasement shall be constructed around the entire pipe from the manhole base to within one foot of the pipe joint if required by the District or City. The pipe encasement shall be constructed integrally with the manhole base. Pipes laid out of the manhole shall be shortened to ensure that the first flexible joint is no more than one foot from the manhole base.

- d. **Concrete Bases (Poured in Place).** The Contractor shall remove water from the excavated area, provide 12 inches minimum layer of compacted 3/4-inch minus of crushed rock for a base, and construct the concrete base so that the first precast manhole section has a uniform bearing throughout the full circumference. There shall be a minimum of eight inches of concrete between the compacted gravel and the lowest invert of the manhole. Twenty-four hours shall elapse before placing the remaining sections on the base, unless otherwise approved by the District or City.
- e. **Placing Manhole Section.** The Contractor shall clean the end of sections of foreign materials and install the preformed plastic gasket in conformance with the manufacturer's recommendations.
- f. **Manhole Inverts.** The Contractor shall construct manhole inverts in conformance with details and with smooth transitions to ensure an unobstructed flow through manhole, and remove all sharp edges or rough sections which tend to obstruct flow.
- g. **Manhole Stubouts.** The Contractor shall install stubouts from manholes for sewer extensions as shown or as required by the District or City. The Contractor shall construct invert channels in accordance with standard drawings. The maximum length of stubouts in existing manholes shall be 15 feet outside the manhole wall with no connections made to the line. The stubout may protrude a maximum of one inch into the manhole. The Contractor shall provide compacted base rock as specified to undisturbed earth under all stubouts. Knockouts may be used in place of stubouts with District or City approval.
- h. **Manhole Extensions, Rings, and Covers.** Rings shall be set in a bed of nonshrinking grout with the nonshrinking grout carried over the flange or the ring and shall be set so that tops of covers are flush with the surface of adjoining pavement, or one foot above natural ground, unless otherwise directed by the District or City. Extensions will be limited to a maximum height of 27 inches from the center point of the first step to the top of the casting.
- i. **Manhole Taps.** Taps into existing manholes shall be core drilled unless approved otherwise by the District or City. All non-concrete pipe material used on a manhole tap shall be adapted with a water tight coupling compatible with concrete or approved equal (e.g., sanded manhole adapter, inserted manhole boot). The bonding material used to connect the pipe and/or coupling to the manhole must be non-shrink material that is approved by the District or City to insure no ground water infiltration occurs.

- j. **Structure Marker.** The District may require that structures located outside the right-of-way be marked with the installation of an approved marking post.

7.02.3 Types of Connections

- a. **Connection to Existing Manholes.** The Contractor shall connect storm lines to existing manholes at locations indicated, provide all diversion facilities and perform all work necessary to maintain storm flow in existing storm systems during connection to the manholes. The Contractor shall break out existing manhole bases or grouting as necessary and re-grout to provide smooth flow into and through existing manholes. The Contractor shall allow no debris to enter the existing system while making the connection.
- b. **Manholes Over Existing Storm Systems.** The Contractor shall construct manholes over existing operating storm lines at locations shown on plans; construct the new base under the existing storm lines and the precast sections as specified. The Contractor shall not break into any existing lines until the system has been tested in accordance with the requirements of Section 7.06 and is ready for acceptance as outlined in Chapter 2. All broken edges shall be covered with nonshrinking grout and troweled smooth. The Contractor shall prevent any debris from entering the manhole while breaking into the existing pipe.

7.03. Catch Basins and Inlets

7.03.1 Materials

- a. **Aggregate, cement and concrete** shall meet the requirements set forth in Section 7.02.
- b. **Frames, Grates and Covers.** All materials shall be flat bar steel (standard grade), cast iron or ductile iron meeting the requirements of ASTM A28 Class 30B.
- c. **Forms.** All exterior surfaces shall be formed with steel or plywood. Other surfaces shall be formed with matched boards, plywood, or other approved material. Trench walls, rock, or earth will not be acceptable form material.
- d. **Metal Reinforcement.** All metal reinforcement shall conform to the requirements of ASTM A615, Grade 60, deformed bars.
- e. **Precast Concrete Units.** All precast units shall conform to the same

requirements as manholes ASTM C478.

7.03.2 Workmanship

- a. Excavation and backfill will conform to the requirements of subsection 5.02.3 Construction.
- b. Bedding. The Contractor shall remove all water and debris from ditch area, provide 8-inches minimum layer of compacted 3/4-inch minus crushed rock for a base.
- c. Cast-in-Place. Cast-in-place catch basins shall have a minimum of 6 inches of concrete between the compacted gravel and the lowest invert. The forms used for cast-in-place catch basins shall be tight and well braced. The storm pipe material being used shall extend into the poured concrete of the catch basin. All corners shall be chamfered. Immediately after placement, the concrete shall be consolidated with an approved vibrator. The top surface shall be screed and exposed surfaces troweled to a smooth finish free from marks or irregularities. After forms are removed, the Contractor shall patch any defects in the concrete with approved material.
- d. Precast. After the base is prepared the Contractor shall set the precast catch basin to the proper line and grade. The storm pipe material being used shall connect to the precast catch basin.
- e. Inverts, Stubouts and Sections. Contractor shall clean the ends of all pipes and sections that come in contact with the catch basin. All inverts, stubouts and sections shall be installed according to the details using a nonshrinking grout, making sure all sharp edges or rough sections are removed, to prevent obstruction of the flow.
- f. Catch Basin Steps. All catch basins deeper than four feet, measured from top of frame to flowline, shall have steps.

7.04 Pipe and Fittings

7.04.1 General

The materials used shall be adequate to carry anticipated dead and live loads within the deflection limits specified by the manufacturer. All pipe and culverts shall have a minimum design service life of 75 years per Oregon Department of Transportation standards.

Joints shall be gasketed unless otherwise approved by the District or City.

7.04.2 Materials

Materials shall be the following types or approved equal:

a. Concrete Pipe (NRCP/RCP)

All concrete pipe and fittings shall conform to the requirements in Section 6.03 Sewer Pipe and Fittings.

b. Ductile Iron Pipe (D.I.P.)

All ductile iron pipe and fittings shall conform to the requirements in Section 6.03 Sewer Pipe and Fittings.

c. Polyvinyl Chloride Pipe (PVC)

All PVC pipe and fittings shall conform to the requirements in Section 6.03 Sewer Pipe and Fittings.

d. A2000 (PVC)

All A2000 PVC pipe and fittings shall conform to ASTM F949 specifications.

e. PVC Rib

PW Rib pipe and fittings shall be made of PVC, as defined in ASTM D1784. The pipe stiffness shall correspond with the series as determined in accordance with ASTM D2412. Series 46 and 28 are allowed.

Gaskets shall conform with ASTM 477.

f. Corrugated Polyethylene (CPP)

Corrugated polyethylene pipe, double wall, and fittings shall be made of polyethylene compounds which conform with the physical requirements of Type III, Category 3, 4 or 5, P23, P33, P34, Class C, with the applicable requirements defined in ASTM D1248. Spiral pipe is not acceptable.

g. Corrugated Aluminum (CAP) and Corrugated Aluminum Pipe Arches (CAPA)

1. Corrugated aluminum pipe and fittings shall conform to the

requirements of AASHTO M196, M197.

2. The connecting bands shall conform to the requirements of AASHTO M196, except the minimum width of bands for 12-inch and larger pipe shall be 12-inches. Minimum width for pipes less than 12-inches shall be 7-inches. The base metal of the connecting bands shall be the same base metal as that of the pipe. The gauge of the connecting bands may be two standard use thicknesses lighter than that used for the pipe, but not less than 0.060 of an inch thick. The band couplers shall be connected with stainless steel bolts of not less than ½ inch diameter.
3. Corrugated aluminum pipe shall not be placed in a ditch in direct contact with hydrating Portland Cement or lime.

7.04.3 Line Tap Saddle

All saddles approved for sanitary sewer tap installation shall be allowed on storm taps except that saddles installed on corrugated aluminum pipe shall be fabricated and installed using stainless steel nuts and bolts.

7.05 Installation

7.05.1 Workmanship

- a. **Line and Grade.** Survey control hubs for both line and grade shall be provided by the Engineer in a manner consistent with accepted practices. The Contractor shall establish line and grade for pipe by the use of lasers or by transferring the cut from the offset stakes to the trench at whatever intervals are necessary to maintain the line and grade. The Contractor shall check line and grade as necessary. In the event that the limits prescribed in these specifications are not met, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding further with the work. Variance from the established line and grade shall not be greater than 1/32-inch per inch of pipe diameter and not to exceed ½ inch, providing that such variation does not result in a level or reverse-sloping invert. Variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, shall not exceed 1/64-inch per inch of pipe diameter, or ½-inch maximum.

Tee stations will be staked by the Engineer to enable the Contractor to install services at proper property location.

- b. **Pipe Handling.** The Contractor shall unload pipe only by approved means.

Pipe shall not be unloaded by dropping to the ground and shall not be dropped or dumped into trenches. The Contractor shall inspect all pipe and fittings prior to lowering into trench to insure no cracked, broken, or otherwise defective materials are used. The Contractor shall clean ends of pipe thoroughly, remove foreign matter and dirt from inside of pipe, and keep it clean during laying and joining. The Contractor shall lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. The Contractor shall remove all damaged pipe from the job site.

- c. Foreign Material. The Contractor shall take all precautions necessary to prevent excavated or other foreign material from entering into the pipe during the laying operation. At all times, when laying operations are not in progress, the Contractor shall use a mechanical plug at the open end of the last laid section of pipe to prevent entry of foreign material or creep of the gasketed joints.
- d. Pipe Laying. Pipe laying shall proceed upgrade with spigot ends pointing in the direction of the flow. After a section of pipe has been lowered into the prepared trench, the Contractor shall clean the end of the pipe to be joined, the inside of the joint, and the rubber ring (if required) immediately before joining the pipe, and make assembly of the joint in accordance with the recommendations of the manufacturer for the type of joint used. The Contractor shall provide all special tools and appliances required for the joint assembly. After the joint has been made, the pipe shall be checked for alignment and grade. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.
- e. Movable Shield. When pipe is laid within a movable trench shield, the Contractor shall take all necessary precautions to prevent pipe joints from pulling apart when moving the shield ahead. The bottom of the shield shall not extend below the springline of the pipe without recompacting the pipe zone.
- f. Cutting Pipe. When cutting or machining the pipe is necessary, the Contractor shall use only tools and methods recommended by the pipe manufacturer and approved by the District or City. The Contractor shall cut cast iron or ductile iron pipe with milling type cutter or with rolling pipe cutter and shall not flame cut.
- g. Transition Fittings. When joining different types of pipes, the Contractor shall use approved rigid fittings. No flexible fittings will be approved. Bell type couplings are considered flexible and are not acceptable.
 - 1. Shear ring/ridge transition couplings meeting the ASTM C564 or

equal shall be used.

2. PVC couplers or adapters shall meet the ASTM 3034-SDR 35/C900-DR 18-D1784 specifications.
 3. Ductile iron transition couplings shall meet the ASTM A536-80 for center and end rings, ASTM D2000 3 BA75 for gaskets and AWWA C-111-80 for bolts and nuts.
- h. **Concrete Closure Collars.** The Contractor shall pour closure collars against undisturbed earth, remove all water from the excavation, construct suitable forms to obtain shapes that will provide full bearing surfaces against undisturbed earth as indicated, and use closure collars only when approved by the District or City, and then only to make connections between dissimilar pipe or where standard rubber-gasketed joints are impractical. Before the closure collars are installed, the Contractor shall wash pipe to remove all loose material and soil from the surface on which they will be placed.
- i. **Pipe Zone.** The Contractor shall install pipe zone material uniformly on both sides of the pipe up to the springline of the pipe. Material shall be compacted to insure proper support within the haunching area.
- j. **Line Taps**
1. Line taps shall be core drilled unless approved otherwise by the District or City. Core drilled holes shall be done using a cylinder style hole saw for only plastic pipe material or a diamond core bit for concrete and ductile iron pipes.
 2. Prior to installation of the saddle, the area around the saddle installation site shall be cleaned and made free of all rough edges.
 3. While installing the saddle, no rock, dirt, or debris shall be allowed to enter the main sewer line from the core hole.
 4. The Contractor shall install 3/4-inch minus gravel in the pipe zone around the line tap, from 4-inches below the pipe or to 6-inches above the pipe.
 5. Magnetic tape shall be installed within 18" of top of pipe on side sewers.

7.06 Testing and Acceptance

7.06.1 General

- a. All gravity storm systems shall be video inspected, pass the required compaction test (AASHTO T99), and a deflection test for plastic pipes. All details of testing procedures shall be subject to approval of the District.
- b. Test Equipment

The Contractor shall furnish all necessary testing equipment and perform the tests in a manner satisfactory to the District or City.

7.06.2 Line Cleaning

Prior to inspection of the system by the District or City, the Contractor shall ball and flush and clean all parts of the system. The Contractor shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at or near the closest downstream manhole. If necessary, the Contractor shall use mechanical rodding or bucketing equipment. Upon the District or City inspection of the system, any foreign matter still present shall be flushed and cleaned from the system as required.

7.06.3 Deflection Test for Flexible Pipe

Storm systems constructed of flexible pipe materials shall be deflection-tested. The test shall be conducted by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the nominal pipe diameter unless otherwise specified by the District. The mandrel shall be a rigid, nonadjustable, odd-numbering-leg (9 legs minimum) mandrel having an effective length of not less than its nominal diameter.

Testing shall be conducted after the line has been completely balled and flushed out with water, and compaction tests have been completed and accepted.

The Contractor will be required to locate and repair any sections failing to pass the test and to retest the section.

7.06.4 Video Inspection of Gravity Systems

All storm systems shall be video inspected and taped prior to the District or City acceptance of the systems. All pipes shall be thoroughly flushed immediately prior to the video inspection. A one-inch target ball shall be placed in front of the camera. If the system is video inspected by a private firm, a copy of the videotape, and a written TV Inspection Report on a form approved by District and

City, shall be supplied to the District or City. The videotape shall be recorded in color and on VHS format. All problems discovered during video inspection shall be noted on the video and the written reports.

7.06.5 Video Inspection for Warranty Acceptance

The storm sewer line shall be video inspected by the District or City during the one year warranty period to determine any defects in the system that are to be corrected by the developer or Contractor.

Chapter 8

ENVIRONMENTAL PROTECTION, EROSION PREVENTION, AND SEDIMENT CONTROL RULES

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Chapter 8

ENVIRONMENTAL PROTECTION, EROSION PREVENTION, AND SEDIMENT CONTROL RULES

8.00 Introduction

This chapter identifies requirements for erosion prevention and sediment control (EPSC). The provisions of this chapter are intended to prevent and reduce adverse impacts to the drainage system and water resources of the Tualatin River basin. In combination with other state, federal, and local laws and ordinances, these requirements are intended to protect the beneficial uses of waters within the Tualatin River Basin and within the Clean Water Services service district.

8.01 General Policy

8.01.1 Erosion Prevention and Sediment Control Policy

In order to meet the stringent water quality requirements of the Tualatin River Basin, the use of erosion prevention techniques shall be emphasized, rather than sediment control measures. This shall be especially important on larger construction sites immediately before and during the rainy season. Erosion prevention techniques are designed to protect soil particles from the force of rain and wind so that they will not erode. These techniques include, but are not limited to, such things as construction scheduling, ground cover, and matting. Sediment control measures are designed to capture soil particles after they have been dislodged and attempt to retain the soil particles on-site. These measures include, but are not limited to, silt fences, sediment barriers, and settling basins. Both erosion prevention techniques and sediment control measures have appropriate uses; however, numerous case studies have shown that sediment control measures are less effective in preventing soil movement than erosion prevention techniques.

8.01.2 Existing Vegetation

- a. As far as is practicable, the existing vegetation shall be protected and left in place, in accordance with the clearing limits on the approved Erosion Prevention and Sediment Control plans. Work areas shall be carefully located and marked to reduce potential damage. Trees shall not be used as anchors for stabilizing working equipment.

- b. Where existing vegetation has been removed, or the original land contours disturbed, the site shall be revegetated, and the vegetation established, as soon as practicable.

8.02 District Enforcement

Failure to comply with any provision of this Chapter or with any term of an Erosion Prevention and Sediment Control Permit shall be deemed a violation of this ordinance and subject to enforcement action pursuant to applicable District and City Ordinance and Resolutions and Orders, including all implementing rules and regulations.

8.03 Erosion Prevention and Sediment Control

8.03.1 Application and Purpose

- a. It is a District requirement to reduce the amount of sediment and other pollutants reaching the public storm and surface water system resulting from development, construction, grading, excavating, clearing, and any other activity which accelerates erosion, to the limits prescribed in this Chapter.
- b. It is the policy of the District to require temporary and permanent measures for all construction projects to lessen the adverse effects of construction on the environment. All projects shall include properly installed, operated, and maintained temporary and permanent erosion control measures as provided in this section and/or in an approved plan, designed to protect the environment during the term of the project. Additionally, compliance with the measures prescribed in this Chapter and/or in an approved plan do not alleviate or diminish the necessity to provide effective and comprehensive erosion prevention and sediment control, as described in Section 8.03.2. These erosion control rules apply to all properties within the CWS boundary, regardless of whether that property is involved in a construction or development activity.
- c. Nothing in this section shall relieve any person of the obligation to comply with the regulations or permits of any federal, state, or local authority.

8.03.2 Erosion Prohibited

- a. Visible or measurable erosion as defined in Chapter 1, which enters, or is likely to enter, the public or private storm and surface water system or other properties, is hereby prohibited, and is a violation of these rules. The owner of the property, permittee under a Site Development Permit,

together with any person or persons, including but not limited to the Contractor or the Engineer causing such erosion, shall be held responsible for violation of these rules.

- b. No person shall create physical erosion by dragging, dropping, tracking, or otherwise placing or depositing, or permitting to be deposited, mud, dirt, rock or other such debris upon a public street or into any part of the public storm and surface water system, or any part of a private storm and surface water system which drains or connects to the public storm and surface water system. Any such deposit of material shall be immediately removed using hand labor or mechanical means. No material shall be washed or flushed into any part of the storm and surface water system until all mechanical means to remove the debris have been exhausted and preventative sediment filtration is in place. The owner of the property, permittee under a Site Development Permit, together with any person or persons, including but not limited to the Contractor or the Engineer who causes such erosion, shall be held responsible for violation of these rules.

8.03.3 Maintenance

The permittee shall maintain the facilities and techniques contained in the approved Erosion Prevention and Sediment Control Plan so as to continue to be effective during the construction phase, post construction phase, establishment of permanent vegetation, or any other permitted activity. If the facilities and techniques approved in an Erosion Prevention and Sediment Control Plan are not effective or sufficient as determined by the District or City site inspection, the permittee shall submit a revised plan within three working days of written notification by the District or City. Upon approval of the revised plan by the District or City, the permittee shall immediately implement the additional facilities and techniques included in the revised plan. In cases where erosion is likely to occur, the District or City may require the applicant to install interim control measures prior to submittal of the revised Erosion Prevention and Sediment Control Plan.

8.03.4 Inspection

- a. District or City Initial Inspection

On a site development or any other type of project, the erosion prevention and sediment control measures shall be installed prior to the start of any permitted activity. The permittee shall call the District or City prior to the foundation inspection of a building for an inspection of the erosion prevention and sediment control measures for that property.

b. Owner Inspections and Inspection Logs

The owner shall be required to inspect Erosion Prevention and Sediment Control measures and provide information on log forms provided by the District. Inspections shall be completed as required by the Erosion Prevention and Sediment Control Planning and Design Manual or the approved plans. Logs are to be maintained on-site and available to District inspectors upon request.

c. Final Inspection

A final erosion control inspection shall be required prior to the sale or conveyance to new property owner(s) or prior to the removal of Erosion Prevention and Sediment Control measurements.

8.03.5 Erosion Prevention Techniques and Methods

The techniques and methods contained and prescribed in the latest addition of the Erosion Prevention and Sediment Control Planning and Design Manual, adopted by Clean Water Services, must be used with the following additional requirements:

a. Gravel Construction Entrance

A gravel construction entrance is required. If there is more than one vehicle access point, a gravel construction entrance shall be required at each entrance. The responsibility for design and performance of the driveway remains with the permittee. Vehicles or equipment shall not enter a property adjacent to a stream, watercourse, or storm and surface water facility, or wetlands unless adequate measures are installed to prevent physical erosion into the water or wetland.

b. Sediment Filters/Barriers

- 1) The use of straw bales as a sediment barrier is not allowed.
- 2) A filter system may not be used on catch basins in public streets as a part of single family erosion prevention and sediment control plans.

c. Plastic Sheeting

Plastic sheeting shall generally not be used as an erosion control measure for single family house construction. Plastic sheeting may be used to protect small, highly erodible areas, or temporary stockpiles of material. If plastic sheeting is used, the path of concentrated flow from the plastic

must be protected.

d. Protection Measure Removal

The erosion prevention and sediment control measures shall remain in place and be maintained in good condition until all disturbed soil areas are permanently stabilized by installation and establishment of landscaping, grass, mulching, or otherwise covered and protected from erosion.

e. Wet Weather Measures

On sites where vegetation and ground cover have been removed, vegetative ground cover shall be planted and established by October 1, or as approved by the District. If ground cover is not established by October 1, the open areas shall be protected through the winter with straw mulch, erosion blankets, or other method(s) approved by the District/City.

f. Exceptions to Sediment Barrier Requirements

Sediment barriers are not required on a site:

- 1) Where there are no concentrated flows and the slope being protected has a grade of less than two (2) percent.
- 2) Where flows are collected through the use of temporary or permanent grading or other means such that the flows are routed to an approved settling pond, filtering system, or sediment barrier.
- 3) Where there are no concentrated flows, slopes are less than 10 percent, and where the run-off passes through a grassed area which is either owned by the applicant, or such use is allowed, by written agreement, by the owner of the grassed area. The grass area shall be at least equal in dimensions to the project area.
- 4) Where the surface is protected by District approved ground cover or matting.

8.03.6 Dust

Dust shall be minimized to the extent practicable, utilizing all measures necessary, including, but not limited to:

- a. Sprinkling haul and access roads and other exposed dust producing areas with water.

- b. Applying District-approved dust palliatives on access and haul roads.
- c. Establishing temporary vegetative cover.
- d. Placing wood chips or other effective mulches on vehicle and pedestrian use areas.
- e. Maintaining the proper moisture condition on all fill surfaces.
- f. Prewetting cut and borrow area surfaces.
- g. Use of covered haul equipment.

8.04 Contaminated Soils

In the event the construction process reveals soils contaminated with hazardous materials or chemicals the Contractor shall stop work immediately, ensure no contaminated material is hauled from the site, remove the contractor's work force from the immediate area of the contaminated area, leaving all machinery and equipment, and secure the area from access by the public until such time as a response team has relieved them of that responsibility. The Contractor shall immediately notify an emergency response team, the District/City, and DEQ of the situation.

Chapter 9

STANDARD TECHNICAL SPECIFICATIONS FOR BUILDING SEWERS, SIDE SEWERS AND SIDE STORM PIPELINES

Section	9.01	General Provisions
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	9.03	Installation of Side Sewers and Side Storms

Chapter 9

STANDARD TECHNICAL SPECIFICATIONS FOR BUILDING SEWERS, SIDE SEWERS, AND SIDE STORM PIPELINES

9.01 General Provisions

The specifications contained herein, together with the State of Oregon Uniform Plumbing Code and all other applicable requirements of federal, state and local law shall govern the installation of all building side sewers, and side storm pipelines. See Section 1.02 for definitions of building sewer, side sewer, and side storm pipelines.

9.01.1 Permits, Fees, Other Requirements

The provisions of District ordinances requiring permits, fees, and other requirements shall be complied with prior to the start of work on any portion of the sanitary or storm pipeline systems.

9.01.2 Service to Lots

Where streets or mainline sewers are being constructed as part of a development, individual side sewers and side storm pipelines shall be constructed to serve each lot.

Where adequate fall exists (from the finished grade of the lot to the street gutter), roof and foundation drains may discharge through weepholes in the curb. Calculations shall be provided with submitted plans showing pipe slope and cover at the minimums required by the appropriate authority. The District may require side storm pipelines instead of allowing weepholes for any project, based upon review of the entire storm drainage system.

Where the District or City wants to minimize trench excavation across existing streets and with prior approval from the District or City, a single side sewer may be constructed to serve two adjacent single family dwellings or two duplexes. This may include flag or infill lots with compatible elevations and where there is limited area to install two separate side sewer trenches. Approval will be contingent on the development meeting all of the following conditions:

- a. The elevation of the lowest floor with plumbing in the buildings to be served must not differ more than 1 foot; and
- b. The side sewer to be constructed must be a minimum of 6-inches in diameter and meet all requirements for public mainline construction as outlined in Chapter 6 of these standards; and

- c. A cleanout meeting the requirements of Standard Drawing 175 must be installed at the right-of-way/property line or a location as approved by the District or City; and
- d. Backflow prevention devices must be installed on each building sewer upstream of the public cleanout; and
- e. No more than two single family dwellings or duplexes may be served by a single side sewer.

9.02 Building Sewer

9.02.1 Licensing of Sewer Contractor

No person other than the owner of the property on which the sewer is being installed or a state or DEQ licensed sewer contractor may excavate or dig up such property and install building sewers within the boundary of the District.

9.02.2 Installation

Building sewers shall be installed in accordance with the Uniform Building Code and Council of American Building Officials (CABO).

9.03 Installation of Side Sewers and Side Storm Pipelines

9.03.1 Material

- a. Pipes for side sewers and side storm sewers constructed within the right-of-way or public easements shall be one of the following types or approved equal:
 - 1. PVC (Polyvinyl chloride), conforming to ASTM D3034. Pipe for side sanitary sewers shall be green. Pipe for side storm sewers shall be white.
 - 2. Ductile iron conforming to Class 50.

9.03.2 Excavation and Backfill

All excavation and backfill shall comply with Section 5.02.

9.03.3 Alignment and Grade

Side sewers or side storms shall be laid in a straight grade and alignment from the main sewer line or storm line respectively, to the edge of right-of-way or edge of permanent easement. The maximum length of a side sewer or side storm pipeline shall be 50 feet. The grade shall be a minimum of 2 percent, or as approved by the District or City. The pipe shall be laid on a pipe base of 4-inches of 3/4-inch minus crushed rock. All plastic pipe shall have 3/4-inch minus rock placed 6-inches over the top of the pipe.

9.03.4 Markings

Side sewers and side storms shall be marked with a detectable underground magnetic tape. The magnetic tape shall be placed from the main pipeline to the end of the side lateral with 18-inches separation between the tape and pipe. The magnetic tape shall be green in color and have the following marking depending on whether it is a sanitary or storm line:

- a. CAUTION SEWER BURIED BELOW
- b. CAUTION STORM DRAIN BURIED BELOW

A 2 x 4 stake shall be installed at the end of the side sanitary or storm extending from the invert of the pipe to 3 feet above the ground surface. The stake shall be marked as whether it is a sanitary or storm side sewer. A magnetic tape shall be placed alongside the 2 x 4.

9.03.5 Testing

Side sewers shall be air tested in accordance with the requirements in Chapter 6.

Chapter 10
TECHNICAL SPECIFICATIONS
FOR WASTEWATER PUMP STATIONS AND FORCE MAINS

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Appendix E - Standard Drawings

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Chapter 10

TECHNICAL SPECIFICATIONS FOR PUMP STATIONS AND PRESSURE MAINS

10.01 General Provisions

The technical specifications contained in this chapter, together with Oregon Department of Environmental Quality and U.S. Environmental Protection Agency standards and any other applicable requirements of federal, state and local law shall govern the character and quality of material, equipment, installation and construction procedures for wastewater pump station, force main and other components of pressurized sanitary sewer work. In addition to the provisions within this Chapter, all applicable provisions of this Resolution and Order shall apply. Administrative provisions of Chapter 2 shall apply to the permit process.

10.01.1 Project Management

An Engineer shall be retained to prepare the design, to manage all design and construction activities, to prepare the Operation and Maintenance manual, and to certify that construction was completed in accordance with the approved construction documents. In the event that the Engineer will not be involved in construction, the Engineer shall provide the District and the Oregon DEQ as applicable a project management plan, in writing, and the owner shall notify the District in writing as to who will assume project management responsibilities. The District shall not manage construction activities or assume project management responsibilities. Construction shall not be undertaken by the owner or the construction contractor until the District has approved the project management plan.

10.01.2 Pump Station in lieu of Gravity Sanitary Sewer

A gravity sanitary sewer system shall be constructed to provide sanitary sewer service to all developments, unless otherwise approved by the District. Owner shall make a request, in writing, to the District for a pump station in lieu of a gravity sanitary sewer prior to submitting an application for a site development permit.

10.01.3 Layout and Sizing Requirements

The design shall provide for the complete construction of a wastewater pump station facility including site improvements; pumps; wetwell structure; valve vault(s); force main piping and appurtenances; gravity sewer piping and appurtenances; surge protection; odor control; plumbing; heating, ventilation, and air conditioning (HVAC) system; electrical power; secondary emergency power connection to support full station loads and control systems;

instrumentation and controls; and other associated work identified by the District as being necessary to make the facility fully functional.

The design shall adhere to and address the minimum layout and sizing requirements described below. Each of the layout and sizing requirements shall be specifically addressed in the pump station design report.

a. Pump Station Style/Configuration

Pump stations shall be of the submersible type, unless otherwise approved in writing by the District.

b. Service Area and Population

Service area shall include all land that can be provided with gravity wastewater collection service, either currently or with future sanitary sewer extensions. Service area shall also include basin(s) which discharge via other wastewater pump stations into the subject basin either currently or in the future as identified through District planning or by District staff. The District shall make the final decision on the extent of the service area. Where applicable, service area shall be consistent with District master planning.

The preliminary design memorandum and final design report shall include a service area map that shows the following:

1. Topography of the pump station site at 2' contours.
2. Topography of the service basin.
3. Property boundaries.
4. Existing and planned service areas.
5. District and City Boundaries.
6. Urban Growth Boundary, as applicable.
7. 100-year flood plain line, as applicable.
8. Property zoning.
9. Proposed pump station location and force main alignment.
10. Existing and proposed gravity collection system.

Service population shall be estimated for the entire service area at build-out and for a 25-year period if build-out is forecast to occur beyond 25 years. Initial service population shall also be estimated. Service population shall be calculated in accordance with and consistent with the District's master plan and other applicable jurisdiction's comprehensive plans, with additional input from District staff. For facilities being constructed as part of a new development, service population shall incorporate actual planned densities.

c. Design Wastewater Flows

Wastewater flows shall be calculated for the following conditions:

1. Start-up, 1-year period, 5-year period, 25-year period, and service area build-out Peak Hourly Flow (PHF).
2. Start-up, 1-year period, 5-year period, 25-year period, and service area build-out Average Dry Weather Flow (ADWF).

Flows shall be calculated in accordance with Chapter 4 of these Standards, and shall include domestic, industrial and infiltration and inflow. Final design flows shall be reviewed and approved by the District.

d. Design Period

Wetwell shall be sized to accommodate full build-out within the identified service area contributing to the pump station, unless otherwise approved by the District.

Pumps/motors, force main, and related equipment shall be sized based on the forecast 25-year PHF.

e. Service Life

Electrical/mechanical systems, including but not limited to pumps, motors, and electrical system, shall be designed and specified to provide for a minimum 25-year service life.

Structures and piping shall be designed and specified for a minimum 75-year service life.

The facility shall be capable of accommodating future components that may be needed for projected growth in the service area beyond the identified design period.

f. Hydraulic Analysis

The Engineer shall evaluate and design the pump/force main system and select pump(s) and force main(s) to provide the required capacity and pressure. The Engineer shall develop hydraulic system curves that indicate the required pump operating conditions. System curves shall be developed for pump suction and discharge piping, and shall include all valves, fittings and other items that may cause energy losses. Analysis shall be provided showing the effects of new and old pipe conditions, the net positive suction head requirements, the hydraulic efficiency, the horsepower requirements, the revolutions per minute, and other operating

conditions required for each pump and combination of pumps. Hydraulic system curves shall be developed using the Hazen-Williams equation for "C" factors of 100, 120 and 150, and under high and low wetwell conditions. Hydraulic system curves shall be overlain on the pump curves. Manufacturer pump curves shall be included in the design report. Computer generated curves may also be included.

The Engineer shall provide pump and system curves for the selected pump(s) to the District for review and approval.

g. Wetwell Size

Sufficient operating volume shall be provided in the wetwell to maintain individual pump starts per hour within the requirements stated herein under the "Pump and Motor" sub-section in Section 10.02. Inlet piping shall not be used to provide storage.

h. Receiving System

Engineer shall evaluate the existing downstream sanitary sewer system of the District or City to determine the impact of the increase in flow (e.g. peak pumping capacity) from the proposed pump station. Evaluation shall be performed under the design flow condition for all pumped and gravity connections to the receiving system. Sanitary sewer system shall be evaluated downstream to a point where no surcharging (caused by the increase in flow from the pump station) above the top of the pipe occurs. Hydraulic profile shall be provided in the design report. The District or City reserves the right to require upgrades to the downstream receiving system to mitigate the impact of the increased flow.

i. Hydrogen Sulfide

Engineer shall evaluate hydrogen sulfide potential in accordance with the following guidelines. Hydrogen sulfide controls shall be designed and constructed based on the following:

1. Detention Time less than 35 minutes: No hydrogen sulfide controls required.
2. Detention Time 35 to 90 minutes: Protect the force main discharge manhole with either a protective coating or with a chemical additive in the concrete. Products shall be approved by the District.
3. Detention Time greater than 90 minutes: Install an active hydrogen sulfide control system.

The detention time shall be calculated as the force main volume divided by the estimated average dry weather flow (ADWF) at the 1-year period after pump station startup.

For pump stations discharging into existing force mains, evaluate existing force main discharge manhole for corrosion per the DEQ guidelines.

j. Reliability/Redundancy

Pumping facilities shall be designed and constructed to meet EPA Class I reliability requirements, which includes pump redundancy, standby power provisions, and a telemetry/SCADA system.

Firm pumping capacity shall be provided. Firm pumping capacity is defined as the ability to discharge the design PHF with the largest unit out of service.

Pumping facilities shall be equipped with a backup control system, which shall operate the entire pump station in the event the primary control system fails. Backup control system shall include water level monitoring device(s) and pump control system(s).

Standby power and telemetry/SCADA systems shall be provided per these Standards.

k. Parcel Size

A standard pump station site requires a minimum of approximately 2000 square feet of land area on a 50' by 40' lot. The minimum parcel size shall be based on the need to provide turn-around and parking for maintenance equipment; accommodate all the pump station structure(s), support enclosures, substructure(s), perimeter site buffer; and be in compliance with all development standards, building code requirements and local jurisdiction planning requirements. Turn-around shall be defined as providing sufficient room for the District's pump station O&M crew vehicle to maneuver within the fenced area. Turn-around shall be designed based on a minimum 60 foot vehicle turning radius, and with no more than four (4) turning maneuvers required to turn the vehicle 180 degrees. The entire pump station site shall be fenced as specified herein. A 15-foot wide buffer shall be provided around the pump station fenced area. Parcel size shall also be large enough to provide for future pump station expansion, within the Design Period/Service Life. See Section 10.02.

l. Parcel Zoning and Other Land Use Requirements

Land use designation for the pump station site shall be consistent with the local jurisdiction's requirements for this type of facility. Site and design shall comply with this Resolution and Order, all relevant land use requirements, and all other applicable local/State/Federal rules and regulations.

m. Parcel Ownership

Pump station site and access road shall be dedicated to the District in the form of a permanent easement, as approved, or transferred into direct ownership. All easements or parcel ownership transfers shall be finalized prior to pump station start-up and acceptance by the District.

n. Storm and Surface Water Management

Storm and surface water runoff from the pump station site, including the access road, shall be managed in accordance with District and all other applicable standards.

10.01.4 Design Procedures

a. General

The Engineer shall provide the following minimum scope of work for wastewater pump station and force main designs. The District may modify and supplement this scope of work to more specifically fit the project.

For projects that involve both a new pump station and force main, they shall be designed together and included in the same construction documents. Construction shall also occur concurrently.

The Engineer shall manage all aspects of the project design and construction process, including all plan review and permitting processes. For any plan review processes beyond the District's including, but not limited to, the Oregon Department of Environmental Quality (DEQ) plan review process, the Engineer shall provide the District with resulting review comments, and shall be responsible for facilitating resolution of any conflicts. The District's final plan approval shall not occur until final approval has been received by the Engineer from all other applicable jurisdictions or regulatory agencies.

b. Project Design Submittals

Project design submittals, including the design report, construction plans, and technical specifications, shall be made to the District at the following intervals:

1. 35% completion
2. 60% completion
3. 90% completion
4. 100% completion

c. Project Review Meetings

1. **Kick-off Meeting:** Prior to the commencement of design and/or construction of any wastewater pump station and/or force main, the Engineer shall contact the District's Treatment Plant Services group to arrange a project kick-off meeting to discuss and review design and equipment requirements. A District project coordinator will be assigned as staff liaison to the Engineer. The District may also form a staff committee to work closely with the Engineer and District project coordinator during the life of the project. The Engineer, after completing the project kick-off, may proceed with the design of the project.
2. **Project Review Meetings:** Following the project kick-off meeting, the Engineer shall, at a minimum, meet with the District to review the documents and receive comments following District review of each submittal.
3. **O&M Staff Meeting:** The Engineer shall also meet with District pump station operations and maintenance staff to tour and inspect applicable existing pump stations to become familiar with District requirements and to clarify and confirm specific pump station design requirements.

Agendas and meeting minutes shall be prepared by the Engineer for all project-related meetings. Meetings shall be scheduled at least ten business days in advance. Agendas and supporting information shall be distributed by the Engineer to all invited attendees at least two business days in advance of any meeting. Meeting minutes shall be distributed to meeting attendees and other interested parties within five business days of the meeting date.

d. Design

The Engineer shall perform the following minimum preliminary design tasks:

1. Review applicable District master plans and design reports.
2. Coordinate with District to finalize the site selection.
3. Coordinate with District to finalize the service area, design population, and design flows.
4. Coordinate with District to confirm downstream receiving system capacity, and to address any hydrogen sulfide control requirements.
5. Perform design surveys.
6. Perform geotechnical investigation work. Develop at least two bore holes where the proposed pump station wetwell will be located, and determine appropriate soil design requirements. Also identify any potential landslide conditions.

The Engineer shall, at a minimum, include the following items with the 35% review submittal:

1. Schematic site design, gravity sanitary sewer connection(s), and force main layout.
2. Preliminary wetwell buoyancy calculations.
3. Preliminary design report. Report shall address how the project responds to the Layout and Sizing requirements specified herein. Report shall also identify all permitting requirements.

Following District review and concurrence with the 35% submittal, the Engineer shall proceed with the design. The Engineer shall perform the following minimum design tasks:

1. Prepare a Final Design Report, consistent with the District and DEQ guidelines.
2. Prepare final construction contract documents, including but not limited to construction drawings and technical specifications.
3. Prepare estimates of construction cost.
4. Submit documents and cost estimate at the scheduled milestones to the District.

e. **Project Construction Documents**

Construction drawings shall include, but not be limited to, the following as deemed applicable by the District and the Engineer:

1. Cover sheet
2. Legend, Symbols and Abbreviations
3. Location and Vicinity Map
4. Pump Station Design Data (see sample table in Appendix)
5. Demolition Plan
6. Site Layout, Grading, Drainage, and Paving Plan
7. Site Utilities, Plans, Profiles, and Details
8. Landscaping
9. Exterior Elevations, Sections, and Details
10. Foundation Plans, Sections, and Details
11. Structure(s) Floor Plans, Sections, and Details
12. Architectural/Civil Framing and Roof Plans, Sections, and Details
13. Door and Window Schedules
14. Mechanical Pump and Piping Plans, Sections, and Details
15. Temporary Pumping Plan
16. Piping Schematics
17. HVAC
18. Electrical Site Plan and Power Plan
19. Power Distribution One-Line Diagram(s)
20. Lighting Plan(s)
21. Electrical Enclosures - One-Line Diagram(s) and Elevation Layouts
22. Miscellaneous Devices/Panels One-Line Diagram(s)
23. Panel Schedule(s) and Layout(s); Circuit Schedule(s)
24. Instrumentation Plan
25. Process and Instrumentation Diagram

Technical specifications shall be prepared to supplement and clarify the construction drawings and these Standards.

10.01.5 **Approval of Alternative Methods or Materials**

See Section 1.17, Approval of Alternative Methods or Materials, of this Resolution and Order.

10.01.6 **Construction Management/Facility Testing Procedures**

a. **General Roles and Responsibilities**

General roles and responsibilities during construction shall be as follows:

1. Contractor shall coordinate directly with the Engineer on all construction issues, including interpretation of contract documents.
2. Engineer shall contact the District regarding any interpretation of Standards and other related District requirements.
3. Engineer shall contact and review with the District any proposed changes to the approved documents. For any change to the approved documents, Engineer shall submit a "Field Revision Form" to the District for approval.
4. District will perform periodic construction observation to verify that work is being performed in accordance with the approved documents. District inspector will not have the authority to approve any aspects of construction activities, nor authorize any changes or modifications.

b. Submittal Reviews

Engineer shall be responsible for obtaining and reviewing contractor submittals to verify that proposed materials and equipment meet the specifications. Furthermore, Engineer shall forward the following submittals to the District for review:

1. Pumps and motors
2. Valves
3. Flow meter
4. Pipe supports
5. Control panel layout
6. Control logic diagrams
7. Generator unit

Engineer shall also forward to the District all requested substitutions to the approved documents, for review.

c. Pre-Construction Conference

Engineer shall facilitate and attend a pre-construction conference meeting with the District, the contractor, the owner, and other interested parties to review roles and responsibilities and to answer questions about the plans and specifications. Engineer shall prepare meeting agenda and provide the District with meeting minutes. Meeting shall be scheduled at least ten business days in advance.

d. Construction Inspection and Meetings

Engineer shall periodically inspect the construction to confirm that the work is being performed in accordance with the approved plans, and to remedy any problems. Engineer shall also meet bi-weekly with the District on site to review construction progress.

e. Construction Check Points

At a minimum, the District will inspect the following items prior to contractor proceeding with work. Engineer shall provide the District a minimum of two business days notice that the subject work will be completed and ready for inspection. Engineer shall be on site to participate in these inspections. Contractor shall not cover or otherwise obscure these work items until inspected by the District.

1. Wetwell Excavation/Base Rock - inspect prior to setting structure; verify compaction.
2. Vault Excavation/Base Rock - inspect prior to setting structure; verify compaction.
3. Piping connections between all structures and the force main - inspect prior to backfilling.
4. Base slabs for generator, electrical and other enclosures - inspect base rock, and verify compaction.
5. Pump base elbow anchor bolts - concurrent with structural testing as specified in Section 10.02.6(e).
6. Factory test of the pump station control panel.
7. Generator test.

District inspection of these and any other items does not relieve the Contractor or owner of responsibility for a complete and operating system.

Copies of compaction test results shall also be provided to the District.

f. Start-up

Engineer shall prepare start-up procedures, final testing procedures, and operational acceptance requirements. A copy shall be provided for District review a minimum of 7 days prior to start-up. Engineer shall coordinate with contractor to test all facility operations prior to performing the formal testing with District staff. Upon completion of the construction and the independent performance testing, the Engineer shall arrange a meeting with the District, Engineer and contractor for formal start-up and testing. Prior to such meeting, Engineer shall notify the District in writing that the pump station has been tested and operates in accordance with the construction document requirements. Engineer shall also be on site to

inspect the formal pump station start-up testing. The contractor shall be required to perform start-up of the new facilities. The equipment manufacturer's representative shall also be on site during all inspection and testing. The representative shall check the installation and supervise start-up. District staff will not operate any aspect of the facility during start-up.

All equipment shall be tested in accordance with the manufacturer's recommendations and as specified or required herein.

The Engineer shall obtain and provide to the District written certification from the manufacturer's representative that the installation is correct and that the equipment has operated satisfactorily.

g. Warranties

The Engineer shall obtain and provide to the District a copy of the manufacturers' warranties for all equipment. These shall be included in the O&M manual.

h. Training

The Engineer and manufacturer's representative shall train the District's personnel in the proper operation and maintenance of the pump station and equipment. The District may videotape the training.

i. Punch List

Following construction and start-up testing, Engineer and District shall develop a punch list of items to be completed or repaired. Contractor shall be responsible for correcting all identified punch list items. Engineer shall provide written confirmation that the work is completed.

j. Project Completion

The Engineer shall obtain and provide to the District a copy of the start-up report as prepared by the manufacturer's representative. The Engineer shall provide certification to the DEQ that all construction was completed per the approved plans and specifications.

10.01.7 Operation and Maintenance Manual

The Engineer shall prepare an Operation and Maintenance manual in accordance District requirements. The manual shall constitute no less than two separate volumes. Volume 1 shall address the fundamental O&M procedures specific to the new pump station. Volume 2 shall provide the equipment

manufacturer's O&M literature specific to the pump station. The District will provide an electronic copy (Microsoft Word format) of the District's standard format for Volume 1. Engineer shall supplement with project specific information.

Specific information that shall be provided in the O&M manual shall include, but not be limited to, the following:

- a. Electrical and control diagrams based on as-constructed conditions. Diagrams shall show the wire colors and numbers, coordinated with the field installation.
- b. Calibration sheets for all calibrated equipment, including model number and serial number of the equipment.
- c. Hard copy of all programming, including (as applicable) auto dialer, soft start/VFD, flow meter, and pump station level controller.
- d. Hard copy of the generator test results.
- e. Vendor list and contact information for all supplied equipment.
- f. Complete set of reduced size record drawings.

The Engineer shall adhere to the following O&M Manual submittal process:

- a. Draft O&M Manual - A draft O&M manual, Volume 1, shall be submitted to the District and the DEQ for review no later than eight (8) weeks prior to pump station start-up. Formatting and attachments shall meet District and DEQ requirements. A 90% version, including both Volumes 1 and 2, shall be submitted to the District for review two (2) weeks prior to pump station start-up.
- b. Final O&M Manual - The final Volume 2 O&M manual, incorporating all District review comments, shall be submitted to the District prior to pump station start-up. Pump station start-up testing shall not proceed without the Volume 2 manual being complete. The final Volume 1 O&M manual shall be updated to address District review comments and to incorporate start-up records, and shall be submitted no later than two (2) weeks following pump station start-up.

10.01.8 As-Built Drawings

For the purposes of this section, as-built drawings will also mean drawings of record, record drawings, or terms indicative of an attempt to record the as-constructed state of the facility.

Following completion of construction, the Engineer shall submit as-built drawings. As-built drawings shall describe any and all revisions to the previously approved construction plans, and shall be accompanied by a certification letter from the Engineer, indicating that the as-built drawings have been reviewed and revised as necessary, to accurately show all known as

constructed details, and that the improvements have been completed in accordance with the District Standards to the best of his/her knowledge. The words "As-Built Drawing" or "Record Drawing" shall appear as the last entry in the revision block along with the month, day, and year the as-built drawing was prepared.

One complete full-size draft set on paper shall be submitted first for checking by District staff. Submission of as-built drawings shall be made within two (2) weeks of acceptance of facilities by the District.

After making changes prompted by District review of the draft paper copy, final As-Built Drawings shall be submitted. All plans shall be prepared using Computer Aided Drafting (CAD), and the final submittal shall include the following:

- a. An AutoCAD compatible digital form (DWG Format) of the as-built drawings (version per District requirements).
- b. Basic layering scheme.
- c. Standard symbols for appurtenances.

10.01.9 Project Review and Acceptance Process

Key aspects of the Project Review and Acceptance Process are as follows:

- a. Request for Pump Station Installation

Owner must first submit a written request to District for permission to install a wastewater pump station in lieu of a gravity sewer.

- b. Gain Approval to Construct Pump Station

District will determine the need for a pump station. If District determines that a proposed pump station is an acceptable alternative to a gravity sewer, District will grant permission to proceed with pump station design.

- c. Number of Copies

Unless otherwise noted, for all project submittals, submit six (6) copies to the District.

- d. Treatment Plant Services Design Review

Pump station/force main design and construction documents shall first be reviewed and approved by Treatment Plant Services (TPS). All submittals shall be delivered to TPS. Upon approval by TPS, the approved construction documents shall be submitted to Development Services.

Development Services will perform a final review of the documents and issue the required construction permits.

e. Coordination with Development Services Reviews

Engineer shall coordinate with Development Services reviews to satisfy requirements associated with the gravity sanitary sewer and additional site layout requirements.

f. DEQ Plan Review

Concurrent with final Development Services review, the owner shall submit final TPS approved plans and specifications to the Oregon Department of Environmental Quality (DEQ) for review. A copy of the DEQ approval shall be submitted to the District before final design approval is issued.

g. Final Design Approval

Upon final District and DEQ reviews and approvals and receipt of appropriate review fees (including separate payment to DEQ for their review fees), Development Services will issue final design approval and the required construction permits. Following issuance of the construction permits, two (2) sets of construction documents will be returned to the Engineer for use during construction. The construction contractor shall at all times use approved plans during construction, and shall maintain such on site.

h. As-built Drawings

Submit one (1) complete set of both paper and electronic as-built drawings.

i. Operation and Maintenance Manual

Submit draft copies to District and DEQ for review. Submit six (6) copies of the final manual. Pump station start-up shall not proceed if the O&M manual submittals are not complete. District will submit final approved copy of Volume 1 to DEQ.

j. Project Acceptance

The pump station can be placed into operation and the District will assume facility operations after all start-up, testing, punch list, O&M manual, and maintenance assurance requirements have been completely satisfied. The

pump station shall not be placed into operation until all these requirements have been addressed, including completion of all punch list items.

k. Timing for Project Reviews

The Treatment Plant Services' review process is separate and independent from the Development Services processes, including those related to public/private sanitary sewer improvements. Development Services' pump station/force main plan review timing will not start until the TPS review process is complete. Upon acceptance of the complete submittals as described in these Standards, TPS will endeavor to approve, return for revision, or reject the documents within 10 working days. Reviewed submittals will be returned to the Engineer, with comments and/or revisions to the documents shown in red.

For construction submittals/substitution requests, the District will endeavor to approve, return for revision, or reject the submittal within 10 working days.

10.01.10 Performance and Other Assurance Requirements

Project performance assurance, "as-built" assurance and maintenance assurance shall be provided as required in Chapters 1 and 2 of these Standards. As specified in Chapter 2, construction punch list generated for the pump station and force main shall be completed prior to release of performance assurance. Treatment Plant Services staff will prepare the construction punch list, following successful pump station start-up.

10.02 Design and Construction Requirements

10.02.1 General

The following requirements are the minimum for the design and construction of wastewater pump stations and force mains. The Engineer shall prepare the design to conform to these requirements and any additional project specific requirements identified during the Project Kick-off meeting and subsequent District reviews. In addition, the design and construction shall comply with all other District standards, as applicable and as referenced herein. In the event of conflicts, these Chapter 10 Standards shall govern.

In general, these Design and Construction Standards require a complete submersible sewage pumping system, equipped with a minimum of two submersible sewage pumps installed in a concrete wetwell. The pumps shall discharge into a sewage force main that empties into a gravity sanitary sewer pipeline. Equipment redundancy shall be provided, unless otherwise specifically noted. The pumping system shall be operated with a fully

independent and automatic control system. Sufficient valves and a flow meter, installed in concrete vaults, shall be provided on the force main. The pump station shall be constructed on a parcel of sufficient size to allow for all required District operations, and the site shall be accessible under any weather condition by District vehicles. The pump station site shall be protected from flooding, and shall be fenced. The pump station shall be provided with all required public and private utility services.

10.02.2 Site

a. Flood Plain

The entire pump station site and access to the site shall be no less than two (2) feet above the 100-year flood plain level. Mapping shall be provided to verify that this requirement has been met.

b. Clearances/Setbacks

Clearances/setbacks from all equipment and structures shall be in accordance with applicable codes, including but not limited to building and electrical codes. Minimum clearances shall be 42 inches in front of all electrical control panels, and 48 inches around the standby generator. Sufficient clearances shall be maintained within the fenced site for access to and ease of equipment maintenance. Setbacks shall also be maintained consistent with local planning requirements.

c. Drainage

Surface water around the perimeter of the site shall be directed away from the pump station. Floors shall be sloped to prevent ponding and to direct water to drains and sumps. All on-site drainage shall drain off the pump station site to an approved point of disposal. Catch basins, if required, shall be Lynch-style, trapped, and minimum four square feet open area. Drainage provisions shall be in compliance with District standards for water quality and erosion control and with all local building codes.

Provisions shall be constructed to prevent flooding of below grade structures. Footing/subsurface drains shall be installed where such drains can be daylighted. See also Section 10.02.3.

d. Access

A minimum twenty (20) foot wide right-of-way and minimum fifteen (15) foot wide asphalt surfaced access road shall be provided for access to the pump station site. Access roads longer than 50 feet shall include at least one turn-around outside the fenced area. Turn-around shall be of

sufficient size for the District's pump station O&M crew vehicle. Turn-around shall be designed based on a minimum 60 foot vehicle turning radius, and with no more than two (2) turning maneuvers required to turn the vehicle 180 degrees. Road grades shall not exceed ten (10) percent. No private gates will be permitted across the access road. Access road shall be designed to provide safe entrance/exit and stopping areas, in accordance with standard road design guidelines.

Within the pump station site, access shall be provided to all structures/equipment for the District's equipment maintenance vehicles.

Access shall also be provided around the entire fenced site to perform required maintenance (see also Parcel Size requirements in Section 10.01).

e. Fencing/Security

The pump station site, including all equipment and structures, shall be enclosed by a six-foot high fence with access gate. Fencing may consist of chain link with obscuring material inserted into the weave of the fence, or it may consist of decorative split face concrete masonry units. Chain link fence shall be 2-inch mesh, 9-gauge copper bearing steel wire, with minimum 15-mil PVC coating. Fence installation shall maintain sufficient clearance from the station and associated structures such that maintenance operations can be accomplished without removal of the fence. See also Clearances/Setbacks.

Access gates shall be rolling or swinging. Swinging gates shall be placed such that both panels can be fully opened to allow entry into the pump station. Gate opening shall be a minimum 15 feet. As applicable, the gate shall be installed to allow a maintenance vehicle to be pulled completely off the public roadway prior to unlocking the gate. Access gates shall allow for padlocking, but security wire and inclined brackets at the fence top shall not be required except in special situations. Gate stops shall be provided for swinging gates.

f. Paving

Access road and entire pump station site shall be surfaced with 8-inches of 3/4 inch minus crushed rock overlain by a 1-1/2 inch thick lift of Class 'B' asphaltic concrete and a 1-1/2 inch thick lift of Class 'C' asphaltic concrete. Compact the crushed rock to 95% maximum dry density in accordance with AASHTO T-99. Compact the asphalt to 92% maximum density in accordance with AASHTO T238 (Method A or B). Place the crushed rock on compacted subgrade. Install geosynthetic fabric on top of compacted subgrade for the full width/length of the access road and within

the pump station site. Perform minimum two compaction tests for both the base rock and asphalt surface.

g. Landscaping

Landscaping shall be provided as required by the development's Land Use Permit. In general, it should be designed to blend-in with surroundings and require little regular maintenance, and be drought resistant to eliminate the need for an automatic irrigation system. Shrubs and/or bushes with thorns shall not be allowed.

h. Lighting

Area lighting shall be provided in accordance with the Electrical requirements as specified herein.

i. Site Sign

District will provide a sign. Sign shall be securely mounted to the fence gate, unless otherwise specified or required by the District.

10.02.3 Wetwell, Vaults, and Related

a. General

1. Applicable Building Codes - Structures shall be designed and constructed consistent with the seismic zone and applicable requirements as specified in the Oregon Structural Specialty Code (OSSC).
2. Testing - Special inspections and/or testing shall be performed on all cast-in-place concrete, anchors, and other structural items as specified in the OSSC.
3. Structural base fill shall consist of 3/4-inch minus crushed rock, compacted to 95% maximum dry density in accordance with AASHTO T-99. Total thickness shall be a minimum of 12 inches. Design shall also incorporate recommendations from the geotechnical investigations. Backfill shall be 3/4-inch minus crushed rock, compacted to 95% maximum dry density in accordance with AASHTO T-99. Backfill shall not be placed against forms or temporary construction materials, or over any debris material. Backfill shall not be placed against poured concrete until 28 days have passed from completion of original concrete pour. Compaction within 5 feet of the walls shall be accomplished using hand operated vibratory plate compactors or

tamping units. Particular care must be taken to avoid damage to the pipe connections and to the structure.

b. Wetwell (see also Chapter 6 of these Standards)

1. Configuration - The wetwell shall be a circular configuration, with consistent diameter throughout. The floor shall be sloped for proper installation and function of the pump inlets. The wetwell shall be designed to minimize the potential for vortexing, rag and debris build-up, and other possible inlet problems. Pump inlets shall be designed at a distance of $0.3D$ to $0.5D$ above the wetwell floor (where D is the diameter of the inlet), but not less than 3 inches. Sump bottom shall be grouted to provide inclined surfaces (60-degree angle to horizontal) to direct solids to the pump inlets. Wetwell shall have one common sump; no split sumps or any barriers shall be installed between pump inlets.
2. Finished Grade Elevation - Wetwell lid shall be a minimum 2 inches above finished grade, to prevent surface water from draining over the lid and into the wetwell.
3. Materials of Construction - Structure shall preferably be precast. Precast concrete wetwells shall meet the standards in Chapter 6 of the District's Standards. Floor slab shall be a minimum 12 inches thick. Top slab shall be designed for H₂O loading. Joints shall be watertight, sealed with rubber ring per ASTM C 443 or mastic gaskets. Joints shall be grouted inside and outside with high strength, non-shrink grout (see also Chapter 6). No lift holes shall be allowed. Alternative lifting mechanisms shall be designed into the structure.
4. Explosion Resistance - All equipment and fixtures installed in the wetwell shall be explosion proof rated in accordance with the applicable electrical codes and as specified herein.
5. Sanitary Sewer Inlet Piping/Isolation - Only one sanitary sewer inlet into the wetwell shall be allowed. Connection shall be flexible, in accordance with Chapter 6 of these Standards. Penetration shall be pre-cast into structure; field constructed penetrations shall not be allowed. No wetwell penetrations shall be made within 6 inches of a wetwell joint. Inside/outside drops shall not be allowed. A pipe joint shall be provided within 12 inches of the wetwell. Inlet discharge shall be above the normal pump operating levels, while minimizing the vertical drop to prevent air entrainment conditions. Inlet piping shall be designed

to avoid vortexing and cavitation. The design shall provide for the isolation of the wetwell, to allow for maintenance.

6. Force Main and Other Pipe Penetrations - Penetrations for the force mains, vault drains, and other required connections shall be pre-cast into structure; field constructed penetrations shall not be allowed. Such pipe penetrations shall be sealed with link seal type seals. For pipe sizes too small for link seals, seal with epoxy sealant.
7. Operating Levels - Inlet piping shall not be used for storage. 'Pumps off' level shall be established to prevent vortexing, and also to provide motor cooling as required by the motor specified. See also pump and motor design requirements and Instrumentation and Control section for additional requirements.
8. Installation - The construction installation method shall be specified and shown on the construction drawings. For any proposed special installation procedures, such as caisson construction, sufficient detail shall be provided for District review.
9. Testing - Perform hydrostatic test in accordance with District standards for manholes.

c. Vaults

1. Size - Vaults shall be no deeper than five feet (5'-0") from the rim to the vault floor. Minimum 12-inch spacing shall be provided between all piping and vault walls/floor, and between vault walls and flanges. Vault shall be large enough to allow for a worker to enter and perform routine maintenance.
2. Finished Grade Elevation - Vault lids shall be a minimum 2 inches above finished grade, to prevent surface water from draining over the lid and into the vaults.
3. Materials of Construction - Vaults shall be constructed of precast concrete, unless otherwise approved by the District. Vaults shall comply with the requirements of ACI 318-99. Concrete shall have minimum 4000 psi, 28 day compressive strength. Joints shall be keyed and shall be provided with a watertight gasket.
4. Construction - Vaults may be formed with separate top and bottom slabs. Walls shall be cast so that all sides are continuous at corners and their full length with no blockouts or knockouts. All pipe

penetrations shall be pre-formed or core drilled at the required locations.

5. Pipe Penetrations - Seal all wall pipe penetrations with link seal type seal. For pipe sizes too small for link seals, seal with epoxy sealant.
 6. Drain - Vault shall gravity drain to the wetwell. Sump pump shall not be allowed. Drain pipe shall be minimum 2-inch diameter. A maintenance-accessible flap valve shall be provided at the discharge end. A P-trap, primed continuously through a connection to the on-site water supply shall be provided as follows. Extend minimum 3/4-inch diameter water line into the vault, terminating at a non-freeze hose bib mounted on the vault wall. Install 1/4-inch tee and ball valve, and extend 1/4-inch diameter copper tubing to the vault drain to serve as the priming supply. Secure all piping to the vault with stainless steel hardware.
 7. Testing - Perform hydrostatic tests in accordance with District Standards for manholes.
- d. Force Main Discharge Manhole

Discharge manhole shall comply with the District's standards for sanitary sewer collection systems. When required herein under hydrogen sulfide management requirements, discharge manholes shall be coated with a District approved protective coating or chemical additive in the concrete.

- e. Access

Wetwell and vault access shall be provided through a minimum double door, 3-foot square opening. Door shall be aluminum, diamond plated, H20 rated, and spring assisted. Door shall be provided with a recessed padlock clip for locking with a standard padlock.

Wetwell access hatch shall be provided with fall prevention system described herein and vault access hatches shall be provided with perimeter drain channels, which shall discharge to daylight through minimum 1-inch diameter pipes at the perimeter of the concrete lid.

- f. Fall Prevention Equipment/Personnel Removal System

Wetwell and vaults shall be designed to conform to Oregon-OSHA requirements. Design shall also comply with District safety standards for personnel entry/removal. Railings, safety grates, or other approved and acceptable systems shall be provided. For wetwells, a grated fall

prevention system integral with the access hatch system shall be provided that meets the following minimum specifications:

1. Provides complete coverage of the wetwell opening when access hatch has been opened.
2. Design allows for visual inspection of the wetwell without opening the fall prevention system.
3. Grating shall be of aluminum construction, with epoxy powder coating, color orange.
4. All stainless steel hardware.
5. 300 psf pedestrian rated.
6. Opens separately from the access hatch. Access hatch must be opened first.
7. Installs and operates without interfering with the pump guide rails. Does not interfere with pump removal.

System shall be the Aluminum Safe Hatch, as manufactured by Syracuse Castings, or equal.

g. Ladders and Miscellaneous Hardware

Access ladders shall not be installed in the wetwell. Ladders shall be provided in vault(s), with recessed extension that extends no less than 3 feet above grade. Ladders shall be constructed of aluminum. Miscellaneous hardware, including anchor bolts, installed in all structures shall be Type 316 stainless steel.

h. Buoyancy

Engineer shall evaluate the buoyancy potential for all buried structures. Engineer shall perform evaluations assuming ground water level at ground surface, and for the wetwell assume that the water level is at "pumps off." Factor of safety against buoyancy shall be a minimum of 1.25 under gravity conditions.

10.02.4 Mechanical

a. Heating and Ventilation

Wetwell and vaults shall be passively ventilated. Electrical equipment within these structures shall be designed to comply with the National Fire Protection Association (NFPA) 820 requirements and the applicable electrical code for this ventilation condition. For the wetwell, passive ventilation through the access hatch alone shall not be sufficient. Vent(s) shall be installed so as not to interfere with vehicular or pedestrian activity related to accessing and maintaining the pump station facility. Above

grade vent pipe shall be Schedule 80 galvanized pipe, protected with a non-corrosive wire mesh screen at the end of the pipe to prevent the entrance of birds, rodents and other small animals. See also the District's Electrical and Instrumentation/Control requirements elsewhere in these Standards for the design of electrical components inside these structures.

Heating and ventilation shall be provided for all electrical and control panels, in accordance with the requirements herein under the "Electrical and Instrumentation/Control Requirements."

b. Plumbing

1. Drainage - Vault drain piping material shall be in accordance with the Uniform Plumbing Code. Site drainage piping material shall be as required for the depth of bury and traffic loading condition. For PVC piping, glue system shall be two-part, including primer and glue. "One Step" systems shall not be allowed.
2. Water Supply - On site potable water supply shall be provided through a metered 1-inch water supply connection to the municipal water supply, with a backflow preventer and a 1-inch yard hydrant. Water piping shall be copper. Yard hydrants in exposed locations subject to freezing shall be of the non-freeze type. Yard hydrant shall be located out of the way of traffic, and shall be secured to and protected by 4-inch diameter galvanized steel bollard filled with concrete.
3. Backflow Prevention - A Conbraco model 40205A2 (1-inch diameter) reduced pressure backflow device shall be installed on the potable water piping entering the pump station site and upstream of any service connections. This device must also be approved by the Oregon State Health Division. Double check valve assemblies are not acceptable. Backflow device shall be installed above grade in a fiberglass enclosure. Above-ground water pipe shall be provided with PVC jacketed insulation and thermostat-controlled heat tape. Power supply to the enclosure shall be provided through a dedicated circuit breaker.
4. Plumbing shall be tested in accordance with Uniform Plumbing Code requirements. Copy of certified test results for backflow prevention device shall be provided.

c. Hydrogen Sulfide Control System

Where an active hydrogen sulfide control system is required by these Standards, system type shall be as directed by the District and design shall

be approved by the District and comply with DEQ guidelines. Systems shall be designed to maintain the dissolved sulfide content of the pumped sewage below 0.1 milligrams per liter at the point of discharge into the gravity sewer manhole.

10.02.5 Force Main and Appurtenances

a. General

Engineer shall design the force main and appurtenances in accordance with American Water Works Association (AWWA) requirements. Minimum force main size shall be four (4) inches in diameter. Design force main velocity shall be 3.5 to 8.0 feet per second. Force main shall be designed to continuously ascend from the pump station to its discharge location, unless otherwise approved by the District. Alignment shall minimize distance from pump station to discharge manhole. Force main shall be installed inside a public right-of-way or permanent easement dedicated to the District (minimum 15 feet wide). Horizontal bends shall be minimized. Use two-45 degree bends in lieu of 90-degree bends. The system shall be designed to allow for the easy removal of pumps, check valves, and flow meter while maintaining the facility in continuous operation.

b. Force Main Pipe and Fittings

All force main piping shall be of the same diameter. Force main piping in the wetwell and through all vaults shall be cement lined, minimum thickness class 53 ductile iron pipe conforming to AWWA C151, without exception. Buried pipe between the vaults and discharge manhole may be cement lined, minimum thickness class 52 ductile iron pipe or polyvinyl chloride (PVC). PVC pipe shall meet AWWA C900, Class 200 (less than or equal to 12 inch diameter) or C905, Class 235 (greater than 12 inch diameter) standards. PVC pipe joints shall meet ASTM D3139 and F477 standards. Fittings shall be factory fabricated cement lined ductile iron, minimum 250 psi rated. Merging of the pump discharge manifold into a common force main shall be made using a 'wye'. Buried joints shall be push-on or mechanical. Flanged buried joints shall not be allowed. Exposed joints shall be flanged. For vertically oriented flanged pipe (e.g. inside the wetwell), piping shall be installed with permanent flanges located on the lower end at all times. Field installed flanges shall only be allowed on the upper end of vertical pipe sections. Joint restraint shall be accomplished mechanically or with concrete thrust blocks. Flexible, restrained connections shall be made outside and within 12 inches of each structure.

Copper toning wire (12 gauge, green) and locate tape shall be installed with all buried force main piping. Toning wire shall be terminated at valve boxes every 500 feet along the force main alignment, or as otherwise required by the District. Toning wire shall also extend from the force main to all air/vacuum valves. Locate tape shall be 4 inches wide, with "WARNING-SANITARY SEWER PIPELINE" or similar printed in large letters on the tape. Toning wire shall be installed on top of the force main; locate tape shall be installed 12 inches above the force main.

Installation of force main and appurtenances shall conform to Chapters 5 and 6 of these Standards, AWWA C600 for ductile iron pipe installation, and AWWA C605 for PVC pipe installation.

c. Check Valves

Each pump discharge shall be fitted with an AWWA C508 check valve installed inside a valve vault. Check valves shall be swing check-type with external arm and spring using metal bushings, mounted in the horizontal position, with flanged end connections. Valves shall be of cast/ductile iron construction, with cast/ductile iron disc, stainless steel hinge pin shaft, replaceable body seat ring, and epoxy lining and coating. Check valves shall be provided with valve (with threaded ends) for pressure relief installed in the top plate or inspection cover, with drain tubing to the vault drain. The valve operators and their orientation shall be drawn to scale on the drawings to clearly identify available operating space. Check valves shall not be installed in the wetwell.

d. Isolation Valves

Each pump discharge shall be fitted with an isolation valve, located inside the check valve vault and immediately downstream of the check valve. An isolation valve shall be installed in the common force main downstream of the flow meter. Isolation valves shall also be installed on the common force main, at intervals not to exceed 1/4 mile. Air/vacuum valves shall be installed upstream of each common force main isolation valve.

Isolation valves shall be cast or ductile iron eccentric plug valves, with flanged end connections and with cast/ductile iron plug. Plug valves 4 inches and larger in diameter shall be gear driven. Valves shall have grit seals on both the upper and lower stem journals. Seat area shall be raised, with raised area completely covered with not less than 90% pure nickel weld. Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the actuator or bonnet from the valve under pressure. Plug valves shall be installed such that the plug opens to the top and the valve seat is located on the pump

side of the valve. Valves in vaults shall have handwheels, with the handwheels operating facing up. Buried valves shall have gear box hermetically sealed and be equipped with 2-inch square AWWA operating nut. The valve operators and their orientation shall be drawn to scale on the drawings to clearly identify available operating space.

e. Air Release Valves

Air relief and air vacuum release, or combination air release and vacuum valves shall be installed at locations along the force main to prevent air from being captured inside the piping, and to allow for draining of the force main. Each such valve shall be sized with the proper orifice size suitable for the volume of air to be admitted or released. Such valves shall be provided with an isolation valve, and with a bleed-off valve at the base. Air release valves shall be stainless steel as manufactured by Vent-o-Mat, without exception. Air release valves shall be installed in a 48-inch diameter concrete manhole with a flat-top lid and 24-inch diameter access cover, all H20 traffic rated.

f. Bypass Connection

Force main shall be provided with a bypass connection at the pump station to allow for temporary bypass pumping and for force main cleaning. The connection shall be located in a vault, downstream of the common force main isolation valve. Connection shall generally be constructed as follows:

1. Connection shall be the same diameter as the force main.
2. Install an in-line wye fitting, rotated vertically.
3. Install a 45-degree bend.
4. Install a plug valve.
5. Install a blind flange on the plug valve, tapped with a 1-inch diameter nipple and gate valve.

g. Force Main Discharge

Force main shall discharge into a manhole at the manhole invert. Force main invert elevation shall not be greater than five feet below ground surface. Where existing sanitary sewer collection system manholes exceed this depth, a separate, dedicated force main discharge manhole shall be provided, with a gravity connection to the sanitary sewer collection system. Where possible, discharge alignment shall be in line with the manhole outlet. Discharge alignment shall not be less than at a 90-degree angle with the outlet.

h. Flow Meter

A flow meter shall be provided on the common force main, either installed in the valve vault or in a separate vault. Flow meter shall be as specified under Electrical and Instrumentation/Control Requirements.

i. Gauges

A pressure gauge shall be installed on each pump discharge, upstream of the check valve. A pressure gauge shall also be installed on the common force main, downstream of the check valves. Gauges shall be 3-1/2-inch diameter with stainless steel case, polycarbonate glass window, stainless steel movement, blowout disc and 1/2-inch NPT stainless steel lower connection. Gauge shall be selected such that the gauge will read from 40 to 70 percent of full scale under normal operating conditions and not exceed 90 percent of full scale under pump curve shut-off condition. Gauges shall be Ashcroft or equal. Gauges shall be mounted to a stainless steel diaphragm seal and filled with glycerin. Gauges and diaphragm seals shall be connected to the force main per the Force Main Pressure Gauge Standard Drawing.

j. Surge Protection

Engineer shall evaluate the pump and force main system to identify the potential for transient pressures or column separation conditions that could damage the pump-force main system. Documentation of the surge analysis shall be included in the design report. Surge protection shall be designed as necessary to avoid a pressure gradient change from positive to negative. Surge protection/column separation prevention measures shall include air cushion check valves, surge anticipation/relief valves, or air relief valves.

k. Supports

Engineer shall size and design pipe supports, as required, for piping in the wetwell and vaults. Supports shall be designed to meet UBC seismic requirements, as applicable, and shall also be designed to resist maximum expected surge. Pipe supports in vaults shall be laid out considering maintenance and removal of valves and the flow meter. Pipe supports in the wetwell shall be designed to minimize horizontal movement of the pipe. In all cases supports shall be provided to prevent transfer of load to flanges, valves, and flow meter.

Supports shall be constructed of 316 stainless steel. Anchors and bolts/nuts shall be minimum Type 316 stainless steel. All concrete anchors shall be epoxy-based.

1. Odor Control System

Engineer shall evaluate the potential for generating odors within the wetwell and at the force main discharge manhole. As required, the Engineer shall size and design an odor control system to minimize or prevent production of odorous compounds. Proposed odor control system shall be reviewed and approved by the District during preliminary design.

m. Painting

Piping and valves in the wetwell and vault(s) shall be painted with epoxy. Prepare and paint in accordance with the Steel Structures Painting Council standards. Paint system shall be applied in minimum three coats, with the first coat being a zinc-based primer. Each paint coat shall be 4 to 6 mils thick. Color shall be as selected by the District.

n. Force Main Testing

Field testing of the force main and appurtenances shall be completed by a hydrostatic test with potable water that meets the following requirements. Contractor shall be responsible for making all necessary provisions for conveying water to the points of use and for disposal of the test water, including temporary taps and plugs.

1. Prior to the start of the hydrostatic test, all trenching shall be backfilled and compacted per the requirements of Chapter 5.
2. When concrete thrust blocks are used, the hydrostatic test shall be conducted at least five days after thrust block installation.
3. Seal pipe ends and secure pipe with temporary thrust restraint, as required, to maintain line and grade and to prevent damage.
4. Furnish all equipment and materials for the test including:
 - a) Test pump approved by the District.
 - b) Suitable suction and discharge pipes and hoses.
 - c) Suitable graduated containers for measuring water loss.
 - d) Pressure gages with pressure range at least 20% greater than the required test pressure and with graduations in 2 psi maximum increments. Gages shall have been calibrated within 90 days of the test.

5. Conduct the hydrostatic test so the lowest point along the test section is subjected to a hydrostatic pressure of 150 psi or 1.5 times the operating pressure, whichever is greater.
6. Fill the test section with water and allow it to stand at two-thirds of the test pressure for a minimum of 12 hours. Expel air from the test section. Apply and maintain the test pressure for a minimum duration of two hours and measure the leakage during this period. Operate the test pump as required to maintain the pressure within plus or minus 5 psi of the test pressure throughout the test period.
7. At the conclusion of the test period, operate the pump until the test pressure is obtained. The pump suction shall be in the graduated container so the amount of water required to restore the test pressure is accurately measured.
8. The measured leakage shall not exceed the allowable leakage amount calculated by the following formula:

$$AL = \frac{LD(P)^{1/2}}{133,200}$$

where: AL = Allowable Leakage in gallons per hour
L = Length of pipe tested in feet
D = Diameter of pipe (nominal) in inches, and
P = Test Pressure in pounds per square inch

9. If the measured leakage is in excess of the allowable leakage, the section of pipe tested shall be repaired and re-tested until the actual leakage is reduced below the allowable amount.
10. Visible leaks in the wetwell and vaults shall be eliminated regardless of the leakage amount.

10.02.6 Pump and Motor

a. General

1. Materials and equipment shall be standard products of both a manufacturer and distributor regularly engaged in both the manufacture and distribution of such products for at least 2 years, and shall be suitable for the service intended. All materials and equipment shall be new and unused.
2. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor

shall be located within a 50-mile radius of the site, and shall be capable of providing 24-hour, 7-day service.

3. The pumps shall be warranted by the manufacturer for a minimum of two (2) years from the date pump station is placed into operation and accepted by the District.
4. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.
5. Wetted parts shall be compatible and suitable for use with raw wastewater.
6. Nameplates - Equipment shall be fitted with a stainless steel nameplate indicating (as applicable) serial number, rated head and flow, horsepower, impeller size, rotating speed and Manufacturer's name and model number.
7. The entire pump station assembly shall be UL approved as Explosion Proof for operation in a Class 1, Division 1, Group D hazardous location.

b. Compatibility

Pumps and pump station equipment shall be compatible with other District pumping stations, and final equipment selection shall be approved by the District.

c. Solids Handling

Pumps shall be capable of handling and passing minimum 3-inch spherical solids and any trash or stringy material.

d. Pumps

1. The Engineer shall select pump(s) that will operate under the determined hydraulic system curve conditions and at the highest efficiency possible. Selection of pump(s) with flat operating curves (e.g. where a small change in total dynamic head results in a large change in pumped flow) shall be avoided. Pump(s) shall operate in accordance with the manufacturer's recommendations under all operating conditions. The entire pump curve shall be non-overloading.

2. Pumps shall be designed for continuous operating service for pumping raw, unscreened sewage, and constructed to meet the intended service.
 3. A minimum of two pumps per station shall be provided.
 4. Pumps shall have tandem double mechanical seals. Lower (primary) seal faces shall be silicon-carbide or tungsten-carbide. Metal parts shall be Type 316 or 316L stainless steel. Probes shall be provided between seals to detect moisture and associated seal failure. A seal leak monitoring system shall be provided by the pump manufacturer. System shall monitor probes continuously for seal leakage. Seal leak monitoring system shall be integrated into the Pump Sequence Control Panel, with a discrete alarm light provided on the front of the control panel.
 5. Pumps shall have replaceable impeller and volute/impeller wear rings. Wear rings shall be constructed of stainless steel.
 6. Impeller shall be of cast/ductile iron construction, non-clog type with pump-out vanes on the back side to reduce pressure on the shaft seal and help eliminate buildup of foreign materials.
 7. Pump assembly shall be painted with a zinc-based primer and a water-based air-dried enamel finish coat. Total paint system thickness shall exceed 2.0 mils, with each coat exceeding 1.0 mil minimum thickness.
 8. Rotational Direction - All pumps shall have the same rotational direction.
 9. Submersible pumps shall not exceed 50 HP. Where a two-pump system would require greater than 50 HP units, three or more units less than or equal to 50 HP shall be installed, with a minimum of two units delivering the design flow rate.
- e. Discharge Elbows

Each pump shall include a separate cast iron discharge base elbow, securely mounted to the wetwell floor with stainless steel epoxy anchors and as specified by the manufacturer. Anchor installation shall be tested in accordance with UBC requirements prior to installation of base elbow. Base elbow shall be a reducing diameter type, as necessary, to transition between pump discharge and the full diameter force main. Pump shall be designed to automatically and firmly connect to the discharge connection,

with sealing of the pump unit to the discharge connection accomplished by a machined metal-to-metal watertight contact.

f. Motors

1. Motors shall be Factory Mutual or Underwriter's Laboratories approved. Pump motor shall be induction type with a squirrel cage rotor, shell type design. Motor shall be housed in a sealed, submersible and explosion proof rated, air or oil filled shell. Motor shall be rated for continuous duty either completely dry or fully submerged in the pumped liquid. A minimum 1.15 service factor shall be specified.
2. Motor shall be minimum NEMA design B with minimum Class F insulation. Stator windings shall be of high conductivity copper magnet wire. Heat sensors shall be embedded into the motor windings, and shall be set to open upon exceeding the motor design temperature. The sensors shall be connected to an alarm in the control panel. Upon a thermal overload, control system shall turn off and lock out pump operation until manually reset.
3. Bearings - The pump and motor assembly shall rotate on two bearings. An upper radial bearing and lower thrust bearing shall be required. These shall be heavy-duty single row ball bearings which are permanently lubricated. Bearings requiring lubrication according to a prescribed schedule are not acceptable. The bearings shall be rated at a minimum B-10 bearing life of 50,000 hours at design loads.
4. Motor nameplate horsepower must exceed the maximum required by the pump under all possible operating conditions. Significant motor oversizing, however, shall be avoided.
5. Electric Cables - Motor and sensor cables shall be heavy duty, submersible type rated to 600 volt and 60 degrees C. The power cable and cap assembly shall be designed to prevent moisture from wicking through the cable assembly. Electrical cables shall be of sufficient length to require no splicing between motor and air gap panel.
6. Cable Entry - The cable entry seal shall be designed to insure a watertight and submersible seal. Power and control cable entry into the lead connection chamber shall include elastomer grommets, washers, and epoxy sealed leads. Epoxies, silicones, or other secondary sealing systems alone shall not be considered acceptable.

7. Motor Starting Frequency - Sufficient wetwell operating volume shall be provided such that motor starting frequency and minimum time between motor starts complies with NEMA requirements.

g. Guide Rails

Each pump shall be easily removed and replaced on two, 2-inch diameter stainless steel guide rails without disturbing the discharge piping. Single rail or cable systems shall not be allowed. Pump assembly shall have lower guide rail supports securely fastened to the base elbow. Guide rails shall be secured to the wetwell lid. Intermediate guide rail supports shall be provided as recommended by the pump manufacturer. Guide rail supports shall not interfere with pump removal or re-installation. Pump discharge shall automatically connect to the base elbow when lowered into place. Entire rail system assembly shall be constructed of stainless steel.

h. Lifting Devices

Each pump assembly shall be provided with a stainless steel lifting chain and stainless steel lifting knuckles of adequate strength to support 150% of the entire assembly weight. Chain links shall be minimum 5/16-inch inside diameter and lifting knuckles shall be provided every 3 feet.

i. Pump Removal

On site hoist and crane shall be provided for pump assembly removal, unless the District's truck-mounted lift has sufficient capacity to lift the pump assembly.

j. Testing

1. Prior to startup testing, Contractor shall remove and re-install each pump to verify that removal system functions correctly, and that the pump/base elbow/guide rail system was installed correctly.

Following successful completion of the startup testing, each pump shall again be removed and re-installed. Each pump shall then be operated to verify that operating conditions at the actual operating point remained constant.

2. Pumps - At a minimum, perform the following tests on each pump:
 - a) Startup, check, and operate the pump system over its entire range. Perform vibration analysis as applicable. Vibration

analysis shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards.

- b) Measure and record the shutoff head and power draw at shutoff head.
- c) Measure and record flow rate, operating head and power draw at actual operating point and at two partially throttled conditions.
- d) Measure and record static head.

Verify that each pump is operating in accordance with its pump curve and as designed. Coordinate with pump manufacturer's representative and contractor to correct any problems. Pump station shall not be accepted until design pump capacity has been demonstrated.

For all pump tests, ensure that the force main is full of liquid during the testing. The facility shall be tested using potable water, unless otherwise approved in writing by the District.

The Engineer shall obtain and provide to the District written certification from the manufacturer's representative that the installation is correct and that the equipment has operated satisfactorily.

- 3. Motors - Simulate High Motor Temperature and Seal Failure to verify that the system provides warnings and protects each pump and motor.

10.02.7 Standby Power

a. General

- 1. Permanent, skid mounted standby AC power engine generator shall be provided on site. Unit shall be mounted on structural channel rails. Install generator on a concrete pad.
- 2. Generator shall be capable of starting and operating the entire pump station, including all pumps.
- 3. The entire engine-generator system shall be built, tested, and shipped so as to assure the unit is factory engineered and assembled so there is one source of supply, service, and warranty responsibility.
- 4. Height of engine-generator and the associated control panel shall not exceed 6 feet.

5. Unit shall be provided with minimum four spring-type vibration isolators with adjusting screws and earthquake restraints for mounting.
 6. Generator unit shall be provided with enclosure that yields a "quiet" operation with maximum average of 69 decibels measured at a distance of 23 feet (7 meters) from the center of the unit. Additional sound dampening shall be provided to meet local noise control code requirements, as required. Entire engine-generator enclosure shall be rated for all-weather outdoor operation. All bolts shall be rust resistant, with lock washers. Doors shall be provided on each side for easy access to unit, and shall be provided with continuous hinges. Doors shall be equipped with adjustable plated pad type locking latches with matched keys. Interior lights shall be provided.
 7. The engine-generator system shall be UL rated under Standard 2200 for Stationary Engine Generator Assemblies.
- b. Generator Unit
1. Generator frequency output shall be 60 Hertz, adjustable from 56 to 64 Hertz.
 2. Voltage output shall be 480 volt, 3-phase. Generator shall have a solid-state voltage regulator capable of maintaining voltage within 1.5 percent at any constant load from 0-100 percent of rating.
 3. Upon application of pump station rated load (all pumps), the instantaneous voltage dip shall not exceed 20 percent (15 percent for VFD driven pumps), and shall recover to the rated voltage within one second.
 4. Generator shall be the brushless alternator type, and windings shall be constructed of copper only.
 5. Generator shall be provided with a unit-mounted circuit breaker with terminals sized for the actual feeder cable.
 6. A hospital grade spark arresting silencer connected to the engine via a stainless steel flexible coupling shall be provided.

c. Fuel

1. Engine generator shall be diesel fueled. Fuel tank shall be full at the time of District acceptance of facility.
2. Day tank shall provide for minimum 24 hours of operation under design peak influent flow loading conditions. Fuel tank shall be a double walled steel tank. Fuel tank shall be integral with the engine generator and installed under the generator, unless such installation would cause the engine generator unit height to exceed that specified herein. Separately mounted tank shall be installed on a concrete pad, and in close proximity to the engine generator.
3. Tank shall be provided with a desiccant dry air filter on vents to prevent condensation of water within the tank. Fuel line to the engine shall be fitted with a large capacity fuel filter and water separator.
4. Fuel tank shall be installed and oriented such that fuel re-filling can be accomplished with no more than 16 feet of hose.

d. Engine Unit

1. Engines shall be air cooled whenever possible. Water cooled engines shall be provided with anti-freeze protection.
2. Turbochargers shall not be allowed.
3. The maximum engine speed shall be 1800 rpm.
4. Engine shall be equipped with an oil sump heater for air cooled types, or an engine block coolant heater for water cooled types. Heater units shall be rated to ensure a preheating temperature of 100 degrees F, and shall provide anti-freeze protection equal to zero (0) degrees F. Heater shall automatically disconnect upon engine start. Heater shall be provided with a dedicated circuit breaker in the main electrical panel.
5. Engine shall be equipped with a heavy duty battery starting system. Battery shall be sized to provide sufficient charge for minimum five (5) cranking cycles at minimum 10-seconds per cycle. A 120-volt trickle charging battery charger with a dedicated circuit breaker in the main electrical panel shall be provided. Charger shall be equipped with an ammeter and voltmeter. Charger shall be capable of recharging the battery to full charge

within one hour. Generator shall provide power to the charger when it is operating.

6. Engine shall have an electronic speed governor that shall hold the engine speed to within 1/2 cycle per second of rated value.

e. Controls

1. The following instruments shall be provided to monitor the engine: oil pressure gauge, engine temperature gauge, RPM tachometer, and total run time meter (hours, non resettable).
2. The following instruments shall be provided to monitor the generator: voltmeter, ammeter, and frequency meter. A panel illumination light shall also be provided.
3. Panel lights shall be provided for the following conditions: emergency generator run status, engine failure due to overheat, low oil pressure, speed (RPM) exceeded, low fuel, and low battery charge.
4. A push-to-test button shall be provided for testing all panel indicator lights.
5. A test-auto-off switch shall be provided for operating the generator.
6. Automatic-emergency shut down shall be provided for the following conditions: over cranking, over speed, low oil pressure, and high coolant temperature. Controls shall be interlocked to drop the electrical load prior to an emergency shut down, and the controls or transfer switch shall include an unloaded generator cool-down delay.

f. Transfer Switch

1. An automatic transfer switch shall be provided that will integrate with and operate the standby generator. The transfer switch shall be UL rated under Standard 1008 for Transfer Switch Equipment. Switch shall be furnished in a UL rated NEMA 1 enclosure and shall be mounted inside weatherproof electrical enclosure #2.
2. Transfer switch shall be electrically operated and mechanically held. Switch shall be mechanically interlocked to ensure only one of two possible positions - normal or emergency.

3. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
4. Switch shall be provided with a microprocessor-based control panel to direct operations. Control panel shall be provided with a keyed disconnect plug to enable the panel to be disconnected from the transfer switch for routine maintenance.
5. Voltage and Frequency Sensing:
 - a) Voltage for each phase of the primary power source shall be monitored continuously, with pickup adjustable from 85% to 100% of nominal, and dropout adjustable from 75% to 98%.
 - b) Single-phase voltage sensing of the emergency source shall be provided, with pickup voltage adjustable from 85% to 100% of nominal and independent frequency sensing with pickup adjustable from 90% to 100%.
 - c) Accuracy shall be within $\pm 2\%$.
 - d) Voltage and frequency settings shall be field adjustable in 1% increments without the use of tools, meters, or power supplies.
6. Time Delays - the following time delays shall be provided, which shall be field adjustable without use of tools:
 - a) Time delay Start: adjustable (0-15 sec) - to prevent nuisance generator set starts in the event of momentary power system loss.
 - b) Transfer Time Delay: adjustable (2-120 sec) - to allow generator set to stabilize before application of load.
 - c) Retransfer Time Delay: adjustable (6-30 minutes) - to allow the power system to stabilize before retransfer of the load.
 - d) STOP delay: adjustable (2 sec to 10 minutes) - to maintain availability of generator set for immediate reconnection in the event the normal source fails shortly after retransfer and to allow gradual generator set cool down by running unloaded.
7. A "commit/no commit to transfer" selector switch shall be provided to select whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

8. Auxiliary contacts shall be provided, consisting of one contact when the switch is connected to the normal source and a second contact when the switch is connected to the emergency source.
9. Indicating lights shall be provided, one to indicate when the switch is connected to the normal source (green) and one to indicate when the switch is connected to the emergency source (red).
10. Engine Exerciser - An engine generator exercising timer shall be provided, including a selector switch to select exercise with or without load transfer. The exerciser shall be programmable to enable exercise for one minute to 24 hours per day in one minute increments for 1 to 7 days per week.
11. The switch manufacturer shall be certified to ISO 9001 and shall have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001.
12. A minimum 100-hour battery backup power supply shall be provided to maintain clock settings during normal loss of power.

g. Testing

1. A factory test shall be performed and a logged test report provided to the District. Test shall be performed using a load bank, with both full load and half load tests performed. Each test shall be performed for minimum 4 hours, and all operating parameters recorded on 15 minute intervals.
2. Generator unit shall be tested on site under full load conditions for two hours. All operating parameters shall be recorded on 15 minute intervals.

10.02.8 Electrical and Instrumentation/Control Requirements

a. General

1. Listing and Labeling
 - a) Unless otherwise specified, electrical equipment and materials shall be listed and labeled for the purpose for which they are used by Underwriters Laboratories Inc. (UL) or Factory Mutual (FM).

- b) All control panels, factory, shop or field assembled, shall be labeled as a unit in accordance with UL 508. The UL 508 label shall be affixed to the inside of the door or cover, adjacent to the data pocket.

2. Instrumentation/Control System

- a) The instrumentation/control system includes all equipment, instruments and wiring for control and monitoring of all pumps and equipment, including custom control panels, motor starting panels and control equipment.
- b) The instrumentation/control system shall be furnished by a single supplier who shall take complete responsibility for the design, assembly and start-up of the complete instrumentation/control system.
- c) The instrumentation/control system supplier shall be regularly engaged in the design and assembly of systems of similar scope and complexity for at least 3 years, and shall be located within a 250-mile radius of the site.
- d) The instrumentation/control system supplier shall provide for time, equipment and support in the shop to factory test the instrumentation/control system in the presence of a District representative. All control functions and all status and alarm monitoring and indication shall be demonstrated under simulated operating conditions. All required corrections shall be provided prior to shipment to the site.

b. Pump Station Operation Overview

The pump station is a typical duplex configuration and is equipped with two submersible pumps. The design intent is that one pump is capable of fully operating the pump station and the other pump is a backup. The operating elevations of the pump station are based from the pump system curves and the known pump station flow capacities as well as the projected future flows. The primary control system of the pump station is by ultrasonic level measurement. The ultrasonic level unit controls the starting and stopping of the pumps. An independent backup high level float switch with true time off cycle timer hardwired relay logic operates the pumps in the event the ultrasonic system should fail. The pump station control modes in descending priority are:

1. Ultrasonic level
2. High level float switch and hardwired cycle timer relay logic.

3. Manual control.

The pump station has a utility power and an in-station permanent standby generator for backup power capable of operating the entire station with both pumps running, sequentially starting. Both pumps shall automatically alternate after each pumping cycle. A pump lead selector switch shall be provided for dedicated pump lead selection. The pump equipment is protected by hardwired interlock to shutdown pump on motor over temperature alarm or motor overload alarm condition. Pump shall not shut down on seal leak/moisture alarm. A dedicated telephone auto dialer shall monitor a minimum of eight critical alarms from the pump station.

c. Electrical Requirements

1. Electrical Service

Standard voltage for pump stations is 480Y/277-Volts, three phase, 4 wire underground service, unless power company dictates otherwise. Power company customer service engineer name and phone number must be available in Specifications and/or on the Construction Plans for contacting during construction. Utility transformer impedance must be shown on One-Line drawing for short circuit available rating requirement.

2. Telephone Service

The standard telephone service to the pump station is a single dedicated voice line with a dual phone jack, one for connection to auto dialer, the other for spare. Telephone company customer service engineer name and phone number must be available in Specifications and/or on the Construction Plans for contacting during construction.

3. Weatherproof Enclosures

- a) There shall be two weatherproof electrical enclosures (#1 and #2). Both weatherproof enclosures shall be NEMA 12/3R, 304 stainless steel free standing 72"Hx72"Wx24"D with double padlock-able doors. The front of both enclosures shall be provided with 24" extended rain shields. Both enclosures shall be installed side by side unless prohibited by site conditions. The site layout shall be approved by the District.

- b) Enclosures shall be equipped with exhaust fans with filter louvers, sized adequately for all heat loss generated by interior equipment in each enclosure. If variable frequency drives are provided, an air conditioner must also be provided and sized accordingly for all heat loss generated by the variable frequency drive equipment at full operation.
- c) Weatherproof electrical enclosure #1 shall house the following equipment:
 - 1) Both combination motor starter panels,
 - 2) Pump sequence control panel,
 - 3) Ultrasonic level indicator/controller,
 - 4) Flow meter indicator transmitter,
 - 5) Auto-dialer, and
 - 6) Miscellaneous devices. i.e. dual-jack phone, duplex outlets, panel lights, heater, exhaust fan, and alarm beacon light mounted on top of the enclosure.
- d) Weatherproof electrical enclosure #2 shall house the following equipment:
 - 1) Automatic transfer switch,
 - 2) Power distribution block,
 - 3) Secondary surge arrestor,
 - 4) Dry type transformer,
 - 5) Dry type transformer primary breaker,
 - 6) Panelboard
 - 7) Panel lights, heater, exhaust fan, duplex outlets, and
 - 8) Space dedicated for O&M books.

4. Main Breaker and Utility Power Meter

- a) Main breaker shall be installed outside weatherproof enclosure #2. Main breaker shall be thermal magnetic type breaker in NEMA 3R enclosure provided with key lock.
- b) The utility service meter enclosure shall be provided per utility power company standards, and shall be installed outside the weatherproof enclosures. Utility service meter can be combined with main breaker as one unit, meter-main.

5. Disconnect Air-Gap Junction Box/Enclosure

A disconnect air-gap junction box/enclosure shall be provided to intercept the submersible pump power and control cables before homeruns to the control panel. The enclosure shall be a NEMA 4X, stainless steel type and shall be installed on a pedestal at a minimum 4'-0" height above ground level and a minimum 3'-0" horizontal clearance from the wetwell wall. The air-gap enclosure configuration is to eliminate the need of providing seal-off on homerun conduits from the wetwell to the control panel.

- a) Disconnect air-gap enclosure shall consist of pump power cable quick-disconnect receptacles with mechanical On-Off interlock switches for connecting one end of pump submersible cables with their matching plugs. The On-Off mechanical interlock switch shall prevent the plug from being disconnected while the receptacle is energized and the switch shall not be capable of being turned "ON" until the plug is inserted properly.
- b) Disconnect air-gap enclosure shall also consist of pump control cable twist-lock connectors and matching plugs dedicated for each pump motor over temp and pump seal leak, and for each wetwell high level float and over flow float switches.
- c) Ultrasonic level transducer cable shall be routed through the air-gap enclosure without splice or quick-disconnect termination.

6. Cable Trench

A common cable trench for pump homerun cables from wetwell to air-gap enclosure shall be installed flush to ground between the wetwell and air-gap enclosure. The trench shall be provided with an accessible top cover. The actual trench dimensions must be sized per NEC cable filled requirement, minimum trench size will be 9" deep and 6" wide with 1/2" thick removable top cover. The trench shall be Synertech Product Plastibeton, model #68, H20 loading capacity or approved equal. The entire trench shall be encased in a minimum 6" concrete all around.

All homerun cables from the wetwell to the air-gap enclosure shall be routed thru the underground channel without conduits. Homerun cables between air-gap enclosure and control panel shall be in conduits without seal-offs.

7. Combination Motor Starter Panels

- a) For pump motor rated less than 25 horsepower or as otherwise required by the electrical utility company, each pump shall be provided with a combination door interlock motor circuit protector and across-the-line starter in NEMA 1 enclosure. Each starter panel shall contain standard components and features, NEMA full size rated starter (NEMA half sizes and IEC contactors are not permitted), door mounted ammeter and overload reset pushbutton.
- b) For pump motor rated equal or greater than 25 horsepower or per utility power service requirement, each pump shall be provided with a combined door interlocked motor circuit protector and soft starter with bypass contactor in NEMA 1 ventilated enclosure. Each starter panel shall contain standard components and features, door mounted ammeter, and overload reset pushbutton. Bypass contactor shall be rated for across-the-line starting capacity.
- c) For pump motor provided with variable frequency drive (VFD), each drive shall be provided with combined door interlocked motor circuit breaker in NEMA 1 ventilated enclosure. The VFD shall be provided with standard components and features: IGBT PWM inverter technology, microprocessor control, 95% minimum operational efficiency, trip-free operation, 0.95 power factor over the entire speed range, input line reactor, input AC fuses, diode rectifier, door mounted customer interface keypad/display, two isolated 4-20mA DC input and output speed signals, and manual speed potentiometer.

Air conditioner must be sized accordingly to VFD heat loss over entire speed operating range with consideration of VFD panel location within weatherproof electrical enclosure.

- d) Combination Starter Panel Accessories - each starter panel shall be provided with the following accessories:
 - 1) Auxiliary overload relay contact (1 N.O. and 1 N.C.)
 - 2) Starter units shall have the same fault current withstand rating as the main power distribution bus fault current withstand rating.

- 3) Bus voltage to 120 V control power transformer:
 - (a) Fused on primary and secondary sides.
 - (b) Control transformer rated for 140 percent of required load.

8. Raceway and Wiring

a) Raceway

- 1) Minimum size conduit shall be ¾ inch.
- 2) Applications:
 - (a) Exposed Interior: Type RGS.
 - (b) Exposed Exterior: Type RGS.
 - (c) Exposed Instrumentation shielded conductors, including routing through manholes and handholes: Type RGS.
 - (d) Direct Buried: Type PVC.
 - (e) Class 1 Division 1 or Corrosive Areas: Type PVC-RGS.
 - (f) Vertical Runs Through Equipment Pad or Grade: Convert PVC conduit to PVC-Coated RGS from 12 inches below top of pad or grade to 6 inches above.

b) Wiring

- 1) Material: Annealed copper.
- 2) Insulation:
 - (a) Conform to applicable requirements of NEMA WC3, WC5, and WC7.
 - (b) No. 8 AWG and Smaller: Type THHN/THWN.
 - (c) No. 6 AWG and Larger: Type XHHW-2.
 - (d) Flexible Cord and Cable. Type SOW-A/50, 600 volts, with ethylene propylene rubber insulation in accordance with UL 62. Also conform to physical and minimum thickness requirements of NEMA WC 8.
 - (e) Type: 600-volt class, stranded.
 - (f) Temperature: NEC 75 degrees C ampacity.
 - (g) Power conductors shall not be smaller than No. 12 AWG.

- (h) Control conductors shall not be smaller than No. 14 AWG.
- (i) Instrumentation conductors shall not be smaller than No. 18 AWG.

3) Color Coding:

- (a) For power and 120V control conductors, provide all single conductors with integral insulation pigmentation of the designated colors through No. 8 AWG. Conductors larger than No. 8 AWG shall be provided with color coding by wrapping the conductor at each end and at all accessible locations with at least six full overlapping turns of colored self-adhesive vinyl tape around the conductor covering an area 1-1/2 to 2 inches wide at a visible location at all conductor termination and pulling points. Vinyl tape shall be 3M Company No. 35, Plymouth Rubber Company, or equal.
- (b) Phase A, B, C implies the direction of positive phase rotation.
- (c) Use the following colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/240 volts Single-Phase, 3-Wire	Grounded Neutral Phase A Phase B	White Black Red
480 volts Three-Phase, 3-Wire	Phase A Phase B Phase C	Brown Orange Yellow
120V ac Control	Single conductors	Red

9. Exterior Fixture

- a) One exterior fixture shall be provided with a control station located inside electrical enclosure #1.
 - 1) Light pole shall be Square Straight aluminum pole, 16 feet height, 9 inches nominal shaft based size/wall thickness, one fixture at 90 degree mounting with standards dark bronze finished color

by Lithonia Lighting part # SSA-16-AC-DM19-DDB.

- 2) Fixture shall be 175 watt Metal Halide, Type IV forward throw, sharp cutoff, 120 volts, 4" square pole arm mounting with Quartz restrike system, Corrosion-resistant finish, CWA Pulse Start Ballast, and Dark Bronze finished color by Lithonia Lighting part # KSF1-175M-44SC-120-SP04-QRS-CR-DDB or approved equal.
- 3) Control station shall be by Intermatic switch No. 885L, 60 minutes with hold feature and rain tight cover.

d. Instrumentation/Control Requirements

1. Level Measurement

- a) Ultrasonic level designated as (LE/LIT) shall be by Milltronics HydroRanger 200 transmitter/controller in NEMA 4X enclosure with portable programmer keypad remote XPS15 transducer. This type of transducer supports small operation radius range requirement. The transducer shall be constructed for 6 degree beam angle, which only requires 1-ft radius clearance for every 10-ft measurement range. Cable length shall be adequate length for homerun from wetwell to level transmitter/controller via air-gap box. No cable splices will be allowed between the transducer and the transmitter/controller.
 - 1) Operation level set points:
 - (a) First set point is lowest in elevation and referred to as the cut-off or pumps stop.
 - (b) Second set point is the lead pump start. Set point shall be a minimum of 12" above first set point.
 - (c) Third set point is the lag pump start. Set point shall be a minimum of 12" above second set point.
 - (d) Fourth set point is high level alarm to dialer and to exterior red beacon light.
- b) High level float backup switch designated as (LSH) shall be provided for pump control in case of ultrasonic level fail. Float switch shall be by Anchor Scientific with adequate cable length for homerun from sensor to air-gap

enclosure with extra 4 feet slack loop in the wetwell. The high float backup switch shall be connected to a true cycle-off delay timer logic to start both pumps sequentially and shall run for an adjustable time (0-30) minutes, preset at 5 minutes. Actual operating minutes shall be calculated based on the wetwell volume. The high backup level alarm shall be connected to the auto dialer and the exterior red beacon light.

- c) Overflow level float switch designated as (LSO) shall be by Anchor Scientific with adequate cable length for homerun from sensor to air-gap enclosure with extra 4 feet slack loop in the wetwell. Overflow switch shall generate the overflow alarm to auto dialer. Pump operation is not connected to this overflow float.

2. Flow Meter

- a) Flow meter shall be electromagnetic type with a remote indicator transmitter. Flow meter shall be cast or ductile iron, Teflon lined and shall be sized to maintain an accuracy of 0.5 percent of flow above 3 ft/sec. Flow meter shall be provided with standard features, zero stability feature to eliminate the need to stop flow to check zero alignment, no obstructions to flow, very low pressure loss. Acceptable manufacturer: Krohne Series 4000 flow meter with IFC 110F electronic converter, 316L SS electrode, with ANSI class 150 flanges and 316L SS grounding rings or approved equal.

- 1) The flow meter/electrode shall be installed in the meter vault.
 - (a) A junction box shall be provided inside the meter vault for conduit intercept.
 - (b) The junction box shall be mounted on the wall inside the vault, but below the electrode mounting height to prevent condensation water travel back to the electrode.
 - (c) The junction box shall be provided with ½” punch hole at the bottom for drainage.
- 2) Flow indicator transmitter shall be mounted in weatherproof electrical enclosure #1.

- (a) Flow indicator transmitter shall read instantaneous flow in gallons per minute. Totalizer shall read in gallons x 1000.

3. Flow Meter Vault Flood Alarm

Flooding of the flow meter vault shall be monitored by a float switch mounted 6-inches above the meter vault floor. The switch and mounting shall be as approved by the District. The meter vault flood switch shall generate a flood alarm to the auto dialer.

4. Pump Sequence Control Panel (PSCP)

Pump sequence control panel shall be in NEMA 12 enclosure. Power to the control panel shall be separately fed from the load center. The enclosure shall consist of the following front mounted control devices:

- a) Control power On-Off switch,
- b) Control power on light (green),
- c) Lead selector switch. (Lead Pump 1 – Alternate – Lead Pump 2),
- d) Hand-Off-Auto switches (each pump),
- e) Running lights (red) - (each pump),
- f) Fail lights (amber) - (each pump),
- g) Motor Over Temperature lights (amber) - (each pump),
- h) Pump Seal leaks (amber) - (each pump),
- i) Running time meters - (each pump),
- j) Beacon light Enable-Disable switch, and
- k) Beacon light Test pushbutton.

5. Pump Sequence Control Auxiliaries:

- a) Relays
 - 1) General:
 - (a) Relay Mounting; Plug-in type socket.
 - (b) Relay Enclosure: Provide dust cover
 - (c) Socket Type: Screw terminal interface with wiring.
 - (d) Socket Mounting; Rail.
 - (e) Furnish hold-down clips.
 - 2) Control Circuit Switching Relay, Non-latching:
 - (a) Type: Compact general purpose plug-in.

- (b) Contact Arrangement: 3 Form C contacts.
- (c) Contact Rating: 10A at 28V dc or 240 ac.
- (d) Contact Material: Silver cadmium oxide alloy.
- (e) Coil Voltage: As noted or shown.
- (f) Coil Power: 1.8 watts (dc), 2.7VA (ac).
- (g) Expected Mechanical Life: 10,000,000 operations.
- (h) Expected Electrical Life at rated load: 100,000 operations.
- (i) Indication Type: Neon or LED indicator lamp.
- (j) Push-to-test button.
- (k) Manufacturer and Product: Potter and Brumfield; Series KUP.

b) Intrinsic Safety Barriers

- 1) GEMS Model 14460 intrinsically safe relays provided in a separate intrinsically safe compartment inside the PSCP enclosure.
- 2) A grounded metal partition provided inside the PSCP enclosure to separate the intrinsically safe relays from non-intrinsically safe components.
- 3) The Float Switch Cables routed in conduit into the PSCP intrinsically safe compartment.

c) Pilot Devices

- 1) Indicating Lights:
 - (a) Heavy-duty, push-to-test LED type, oil tight, industrial type for 120V ac applications.
 - (b) Screwed on prismatic glass lenses in colors noted and factory engraved legend plates for service legend.
 - (c) Manufacturers and Products:
 - (1) Cutler-Hammer; Type 10250T.
 - (2) General Electric; CR 2940U
 - (3) Allen Bradley; Type 800H
- 2) Selector Switch and Push Button:
 - (a) Heavy-duty, oil tight industrial type with contacts rated for 120V ac service at 10 amperes continuous.

- (b) Standard size, white field, legend plates with black markings, for service legend.
 - (c) Selector Switch Operator: Black knob type.
 - (d) Single hole mounting, accommodating panel thicknesses from 1/16 to ¼ inch.
 - (e) Manufacturers and Products:
 - (1) Cutler Hammer; Type T.
 - (2) Square D; Type K.
- d) Time Delay Relay
- 1) On Timer and Off Timer:
 - (a) Multi-function operation with two Form-C delayed output contacts.
 - (b) Time delay range as specified or shown in the drawings.
 - (c) Heavy duty.
 - (d) Manufacturers and Products:
 - (1) Idec.
 - (2) Eagle Signal Controls.
- e) Elapsed Time Meter (Hour Meter)
- 1) Six-digit wheels including a 1/10 digit.
 - 2) Automatic recycle at zero.
 - 3) Time range in hours.
 - 4) Accuracy: 1 percent.
 - 5) Sealed against dirt and moisture.
 - 6) Tamper-proof and non-resettable.
 - 7) Manufacturers and Products:
 - (a) Eagle Signal Controls.
 - (b) Or equal.
- f) Panel Wiring
- 1) Power and Control Wiring: 600-volt class, insulated, stranded copper.
 - (a) Size: Minimum 14 AWG enclosed in either sheet metal raceway or wiring duct.
 - 2) Signal Circuit Wiring: Twisted shielded pairs minimum No. 16 AWG, separated at least 6 inches from power wiring.

- 3) Identification: Permanent heat impregnated polyvinyl chloride (PVC) alpha-numeric labels.

6. Alarm Exterior Beacon Light

Alarm exterior light shall be provided with beacon weatherproof type, 120Vac. The beacon light shall be mounted extended on top of weatherproof electrical enclosure #1 and extended to be visible from the nearest public road way. The high level alarm contacts from ultrasonic level and high level float switch shall be connected to this beacon light. The beacon light shall be equipped with Enable-Disable selector switch and a Beacon Test pushbutton, both mounted on the front of the pump sequence control panel. The high water alarm will be automatic reset. No latching contact is required. (No audible alarm is required). The beacon light shall be by Federal Signal part # 225-120VAC-RED.

7. Auto Dialer

A dedicated telephone auto dialer shall be provided. Auto dialer shall be by Phonetics Inc. Sensaphone Express II with 8-channels minimum and built-in power failure monitoring. No substitution allowed. Alarm contacts shall be monitored by auto dialer as follows:

- 1) Overflow.
- 2) High wetwell (from ultrasonic high level set point or high level float backup).
- 3) Pump 1 fail (from motor overload or motor over temperature).
- 4) Pump 2 fail (from motor overload or motor over temperature).
- 5) All pumps running (from motor starter auxiliary contactors).
- 6) Standby generator on (from generator running auxiliary contact).
- 7) Control power fail (from 120Vac control power relay).
- 8) Flow meter vault flooding (from meter vault flood switch).
- *) Auto dialer power failure (internal alarm).

8. Telephone Jack Configuration

A dedicated telephone line shall be provided for auto dialer communication. The telephone jack shall be a duplex port type. One port is dedicated for the auto dialer connection and the other

port is for testing purpose. Duplex phone shall be by Radio Shack, cat #279-448 or approved equal.

d. Calibration Sheets and Templates

Electronic copies of the following instrumentation calibration sheets and templates shall be provided by the District where applicable during the project design phase. They shall be filled out by the Engineer and returned to the District, with paper copies inserted in the O&M manual:

1. Ultrasonic Level Transmitter/Controller Parameters.
2. Auto Dialer Parameters.
3. Electromagnetic Flow Meter Parameters.
4. Soft Starter or Variable Frequency Drive Parameters.

Chapter 11

SEPTIC TANK EFFLUENT PUMP (STEP) SYSTEMS

- Section 11.01 General Provisions
- 11.02 Technical Specifications
- 11.03 Application
- 11.04 Inspection

Chapter 11

SEPTIC TANK EFFLUENT PUMP (STEP) SYSTEMS

11.01 General Provisions

With the approval of the District, STEP systems which pump to a public sewer line may be installed when:

- a. A public gravity sewer is adjacent to the lot, and
- b. Gravity access to a public sewer line cannot reasonably be obtained, and
- c. The District determines that a public pump station serving multiple properties is not a more appropriate solution, and
- d. Only one house or building is connected to the STEP system and pressure line, and
- e. Unless approved by the District, the public sewer line at the point of connection is a polyvinyl chloride (PVC) material, and flows in the public line are such that hydrogen sulfide generation will not be a problem.

The STEP system operation, maintenance, electricity, replacement, and sludge removal costs are the responsibility of the property owner. The property owner is also responsible for the repair or replacement of the tank and connections if infiltration occurs.

The District shall be permitted to enter upon private property for the purpose of inspection, observation, measurement, sampling, and testing of the STEP system.

11.02 Technical Specifications

11.02.1 On-Site Interceptor Tank

- a. Tanks shall be 1000 gallon precast concrete, fiberglass or polyethylene and shall have been designed by a registered engineer and approved by the local regulatory agencies. The manufacturer shall provide the structural design and certification to the District for review.
- b. The tank shall be guaranteed in writing by the tank manufacturer for a period of two years from the date of delivery to the site.
- c. The tank shall successfully pass a hydrostatic test at the time of manufacture and after installation at the site. An alternate method is a vacuum test. The hydrostatic test shall measure the water loss due to exfiltration during a two-hour period where the tank is filled with water to

the riser. The two-hour loss shall not exceed six gallons for concrete, and no loss for polyethylene and fiberglass tanks.

- d. The tank shall be installed in accordance with the manufacturer's instructions. The installation and testing shall be witnessed by District personnel.

11.02.2 Risers and Lids

- a. Inlet risers, if required, shall be ribbed PVC. Risers shall be at least 12-inches high and shall have a minimum nominal diameter of 21-inches.
- b. Outlet risers shall be ribbed PVC. Outlet risers shall be at least 12-inches high and a minimum nominal diameter of 24-inches.
- c. Lids shall be Orenco Systems Model FL-21g or FL-24g, or equal, and provided with neoprene gasket, and stainless steel bolts.
- d. Risers and lids shall be free from infiltration.

11.02.3 Pumping Assemblies

The pumping system shall be an Orenco Pumping System, or equal, that is designed by a registered engineer to meet the application of its intended use.

11.03 Application

The applicant shall submit to the District or City two copies of the engineering plans prepared by a licensed professional engineer. The application shall also show that gravity sewer is not available to the lot, that there is no practical way to serve the lot with gravity sewer, and that there will not be a hydrogen sulfide problem at the point of connection to the gravity system.

The District may set and charge additional fees for the plan review and inspection of STEP system installations.

Prior to final acceptance by the District, the property owner must furnish an easement for access to the property stating that a STEP system exists on the property, that it is a private system (not owned or maintained by the District), and that the District shall be permitted to enter upon the subject property for the purpose of inspection, observation, measurement, sampling, and testing of the STEP system.

11.04 Inspection

Inspection and testing of the individual STEP system shall be required prior to final acceptance by the District.

Chapter 12

PROHIBITED ACTIVITIES

12.01 Prohibited Activities

12.01.1 In addition to the restrictions of Ordinance 27, Section 3.B, the following activities are prohibited, except as expressly allowed or approved by District / City/ County permit:

- a. The discharge, placement, deposit, dumping or otherwise contributing a solid or liquid material into the public storm and surface water system, either directly or indirectly, which may obstruct flow or otherwise interfere with the operation or function of a public storm and surface water facility. This shall include, but is not limited to, placing of soil or rock without an approved fill permit, or the dumping of debris, yard waste, rubbish, trash, or other waste material.
- b. The operation of a motor vehicle on native ground in a Sensitive Area or Vegetated Corridor.
- c. The removal of native vegetation in a Sensitive Area or Vegetated Corridor.
- d. The interruption of a natural water source to a Sensitive Area.
- e. The removal of non-native invasive vegetation from a Sensitive Area, Vegetated Corridor, or Storm Water Infrastructure other than with an integrated vegetation management approach.
- f. The use of pesticides on property, including easements, owned by a city, county or other political subdivision, including the District.

12.01.2 Violation of this Chapter is subject to enforcement by the District and City pursuant to applicable ordinances and rules.

**APPENDIX A:
HYDROLOGY AND HYDRAULICS**

1.0 HYDROLOGIC ANALYSIS

This section presents acceptable methodology for estimating the quantity and characteristics of surface water runoff, as well as the assumptions and data required as input to the methods. These methods should be used to analyze existing and design proposed drainage systems and related facilities.

1.1 Rational Method

The rational method for analyzing small drainage basins is allowed with the following limitations:

- a. Only for use in predicting a conservative peak flow rate to be used in determining the required capacity for conveyance elements.
- b. Drainage subbasin area cannot exceed 25 acres for a single calculation without approval from District or City.
- c. The time of concentration shall be five minutes when computed to be less than five minutes.
- d. Rainfall intensities shall be from the following IDF Table or an alternative approved by the District.

**RATIONAL METHOD
RAINFALL INTENSITIES FOR EAST WASHINGTON COUNTY**

Rainfall Intensity (inches per hour)

TIME OF CONCENTRATION (MIN)	STORM EVENT: YR / (PROBABILITY)					
	2 (50%)	5 (20%)	10 (10%)	25 (4%)	50 (2%)	100 (1%)
0	1.90	2.50	3.00	3.40	4.00	4.50
5	1.90	2.50	3.00	3.40	4.00	4.50
10	1.30	1.70	2.20	2.50	3.00	3.50
15	1.10	1.40	1.80	2.10	2.50	2.90
20	0.90	1.20	1.50	1.80	2.10	2.40
30	0.75	0.95	1.20	1.40	1.65	1.90
40	0.60	0.75	1.00	1.15	1.30	1.60
50	0.55	0.70	0.85	1.00	1.15	1.35
70	0.45	0.55	0.70	0.82	0.95	1.10
100	0.40	0.45	0.55	0.67	0.75	0.90
180 or more	0.35	0.40	0.50	0.60	0.70	0.85

1.2 Unit Hydrograph Methods

- a. To obtain a realistic and consistent hydrologic analysis for each development site, all developments shall use the hydrograph analysis method for drainage planning and design unless otherwise approved in advance by the District. The physical characteristics of the site and the design storm shall be used to determine the magnitude, volume and duration of the runoff hydrograph. The Santa Barbara Urban Hydrograph (SBUH) will be the primary acceptable unit hydrograph method.

The "HYD" computer program, developed by King County, Washington in its Surface Water Design Manual, January 1990 uses these methods to generate, add and route hydrographs. The District will check all hydrologic calculations using the King County "HYD" program. However, the District will allow the use of the rational method for analysis of drainage basins of 25 acres or less.

- b. The Design Storm
- 1) Return frequency and duration specify the design storm event. The design storms shall be based on two parameters:
 - a) Total rainfall (depth in inches).

b) Rainfall distribution (dimensionless).

c. Design Storm Distribution

- 1) The rainfall distribution to be used within the District is the design storm of 24-hour duration based on the standard NRCS Type 1A rainfall distribution using the chart on the following page. The total depth of rainfall for storms of 24-hour duration and 2, 5, 10, 25, 50 and 100 year recurrence are 2.50, 3.10, 3.45, 3.90, 4.20, 4.50 inches respectively.

Recurrence Interval (years)	Total Precipitation Depth (in)
2	2.50
5	3.10
10	3.45
25	3.90
50	4.20
100	4.50

- 2) The following table contains the NRCS Type 1A precipitation distribution.

DESIGN STORM DISTRIBUTION CHART

Hour	Percent Rainfall		<u>Rainfall Depth, (Inches)</u>						
	Incremental	Cumulative	2YR	5YR	10YR	25YR	50YR	100YR	
			2.50	3.10	3.45	3.90	4.20	4.50	
1	2.40	2.40	0.06	0.07	0.08	0.09	0.10	0.11	
2	2.60	5.00	0.07	0.08	0.09	0.10	0.11	0.12	
3	3.20	8.20	0.08	0.10	0.11	0.12	0.13	0.14	
4	3.80	12.00	0.10	0.12	0.13	0.15	0.16	0.17	
5	4.44	16.44	0.11	0.14	0.15	0.17	0.19	0.20	
6	5.18	21.62	0.13	0.16	0.18	0.20	0.22	0.23	
7	6.48	28.10	0.16	0.20	0.22	0.25	0.27	0.29	
8	16.44	44.54	0.41	0.51	0.57	0.64	0.69	0.74	
9	7.58	52.12	0.19	0.23	0.26	0.30	0.32	0.34	
10	5.28	57.40	0.13	0.16	0.18	0.21	0.22	0.24	
11	4.96	62.36	0.12	0.15	0.17	0.19	0.21	0.22	
12	4.32	66.68	0.11	0.13	0.15	0.17	0.18	0.19	
13	4.02	70.70	0.10	0.12	0.14	0.16	0.17	0.18	
14	3.42	74.12	0.09	0.11	0.12	0.13	0.14	0.15	
15	3.28	77.40	0.08	0.10	0.11	0.13	0.14	0.15	
16	3.00	80.40	0.08	0.09	0.10	0.12	0.13	0.14	
17	2.80	83.20	0.07	0.09	0.10	0.11	0.12	0.13	
18	2.40	85.60	0.06	0.07	0.08	0.09	0.10	0.11	
19	2.40	88.00	0.06	0.07	0.08	0.09	0.10	0.11	
20	2.40	90.40	0.06	0.07	0.08	0.09	0.10	0.11	
21	2.40	92.80	0.06	0.07	0.08	0.09	0.10	0.11	
22	2.40	95.20	0.06	0.07	0.08	0.09	0.10	0.11	
23	2.40	97.60	0.06	0.07	0.08	0.09	0.10	0.11	
24	2.40	100.00	0.06	0.07	0.08	0.09	0.10	0.11	

The above table is from the "Subbasin Hydrologic Modeling Criteria" by Kramer, Chin, & Mayo Inc., 1991.

d. Runoff Parameters

The physical drainage basin characteristics listed below shall be used to develop the runoff hydrograph.

- 1) Area
- 2) Curve Number
- 3) Time of Concentration

a) Selection of Area:

To obtain the highest degree of accuracy in hydrograph analysis requires the proper selection of homogeneous basin areas. Significant differences in land use within a given basin must be addressed by dividing the basin area into subbasin areas of similar land use and/or runoff characteristics. Hydrographs should be computed for each subbasin area and superimposed to form the total runoff hydrograph for the basin.

All pervious and impervious areas within a given basin or subbasin shall be analyzed separately. This may be done by either computing separate hydrographs or computing the precipitation excess. The total precipitation excess is then used to develop the runoff hydrograph. By analyzing pervious and impervious areas separately the cumulative errors associated with averaging these areas are avoided and the true shape of the runoff hydrograph is better approximated.

b) Selection of Curve Number:

The Natural Resources Conservation Service (NRCS) (formerly referred to as the Soil Conservation Service (SCS)) has developed "curve number" (CN) values based on soil type and land use. The combination of these two factors is called the "soil-cover complex."

The soil-cover complexes have been assigned to one of four hydrologic soil groups, according to their runoff characteristics. Soil Hydrologic Groups may be found in Table 13, Soil Survey of Washington County, Oregon (SCS July 1982).

The following are important criteria/considerations for selection of CN values:

- (1) Many factors may affect the CN value for a given land use. For example, the movement of heavy equipment over bare ground may compact the soil so that it has a lower infiltration rate and greater runoff potential.
- (2) CN values can be area weighted when they apply to pervious areas of similar CN (within 20 CN points). However, high CN areas should not be combined with low CN areas (unless the low CN areas are less than 15 percent of the subbasin).
- (3) Antecedent soil moisture values should be considered. Soil should be considered to be moist prior to the start of the precipitation event.

c) SCS Curve Number Equations:

The rainfall-runoff equations of the NRCS curve number method relate a land area's runoff depth (precipitation excess) to the precipitation it receives and to its natural storage capacity, as follows:

$$Q_d = (P_R - 0.2S)^2 / (P_R + 0.8S) \text{ for } P_R > 0.2S; \text{ and}$$

$$Q_d = 0 \text{ for } P_R < 0.2S$$

Where

- Q_d = runoff depth in inches over the area,
- P_R = precipitation depth in inches over the area,
- S = potential maximum natural detention, in inches over the area, due to infiltration, storage, etc.

The area's potential maximum detention, S, is related to its curve number, CN:

$$S = (1000/CN) - 10$$

The computed runoff represents inches over the tributary area. Therefore, the total volume of runoff is found by multiplying Q_d by the area (with necessary conversions):

$$\text{Total Runoff Volume (cubic-feet)} = Q_d \text{ (in)} \times A \text{ (ac)} \times 3,630 \text{ (cubic-feet/(ac-in))}$$

When developing the runoff hydrograph, the above equation for Qd is used to compute the incremental runoff depth for each time interval from the incremental precipitation depth given by the design storm hyetograph. This time distribution runoff depth is often referred to as the precipitation excess and provides the basis for synthesizing the runoff hydrograph.

d) Time of Concentration:

Time of concentration (T_c) is the time for runoff to travel from the hydraulically most distant point of the watershed to the point where the hydrograph is to be calculated. Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c). T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system. T_c influences the shape and peak of the runoff hydrograph.

(1) Sheet Flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. For sheet flow up to 300 feet, use the kinematics solution below to directly compute T_t :

$$\text{Sheet Flow: } T_t = (0.93L^{0.6} \times n^{0.3}) / (I^{0.4} \times S^{0.3})$$

- Where T_t = travel time (min)
- n = Manning's effective roughness coefficient for sheet flow
- L = flow length (ft)
- I = rainfall intensity in inches per hour
- S = slope of hydraulic grade line (ft/ft)

Sheet flow shall not be used for distances exceeding 300-feet.

(2) Shallow Concentrated Flow

For slopes less than 0.005 ft/ft the following equations can be used:

- a) For Unpaved Surfaces: $V = 16.1345 (S)^{0.5}$
- b) For Paved Surfaces: $V = 20.3282 (S)^{0.5}$

Where: V = velocity in feet per second
S = Slope in ft/ft

(3) Channel Flow

A commonly used method of computing average velocity of flow, once it has measurable depth, is the following equation:

$$V = (1.486/n) \times R^{0.6} \times S^{0.5}$$

Where: V = velocity (ft/s)
n = Manning's roughness coefficient
S = slope of flow path (ft/ft)
R = area/perimeter

1.3 Water Quality Hydrology

Water Quality

The water quality storm is the storm required by regulations to be treated. The storm defines both the volume and rate of runoff.

- a. Water Quality Storm: Total precipitation of 0.36 inches falling in 4 hours with a storm return period of 96 hours.

Water quality volume (WQV) is the volume of water that is produced by the water quality storm.

- b. Water Quality Volume (WQV): 0.36-inches over 100-percent of the new impervious area.

$$\text{Water Quality Volume (cf)} = \frac{0.36(\text{in}) \times \text{Area (sf)}}{12 (\text{in/ft})}$$

- c. Water Quality Flow (WQF): The average design flow anticipated from the water quality storm.

$$\text{Water Quality Flow (cfs)} = \frac{\text{Water Quality Volume (cf)}}{14,400 \text{ Sec}}$$

or

$$\text{Water Quality Flow (cfs)} = \frac{0.36(\text{in}) \times \text{Area (sf)}}{12(\text{in/ft})(4 \text{ hr})(60 \text{ min/hr})(60 \text{ sec/min})}$$

2.0 HYDRAULICS

2.1 Catch Basins

Catch basins and inlets collect water from an adjacent ditch, gutter line, or pavement and convey the water to a storm sewer system or culvert. The inlet systems are to be designed in accordance with the following criteria:

- a. Chapter 3 of CWS's Design and Construction Standards:
 - 1) The following methodologies shall be used in locating catch basins and inlets:
 - (a) ODOT Hydraulics Manual.
 - (b) Hydraulic Engineering Circular No. 12 (FHWA-TS-84-202) Drainage of Highway Pavements.

2.2 Area Drains

The maximum acceptable intake flow rate for Type II area drains and ditch inlets are as follows:

Grate Angle 30°

Hydraulic Head (ft)*	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.0	10.0
Flowrates Q(cfs)**	2.0	5.6	10.3	11.9	13.3	14.6	16.8	18.8	22.3	26.6

* Measured from bottom of grate to headwater

** Cubic feet per second

2.3 Channel Protection

Open channels shall be designed to prevent scouring of the channel. Where rip rap protection is specified, rip rap protection shall be placed over a filter fabric base or a minimum 6" thick gravel base. The following provides additional design guidance in assisting the design Engineer, however, the design Engineer shall be responsible for the final design.

PROTECTION FOR NEW CHANNEL CONSTRUCTION

Velocity at Design Flow (fps)		Required Protection	Thickness	Minimum Height above Design Water Surface
Greater than	Less than or equal to			
0	5	Vegetation Lining	N/A	0.5 ft.
5	8	Bioengineered lining* Or ODOT Class 50** Riprap	N/A 1.5 ft.	1 ft.
8	12	ODOT Class 200** Riprap	2.5 ft.	2 ft.
12	20	Slope Mattress, etc.***	Varies	2 ft.

* Bioengineered lining allowed for greater than 5 fps.

** ODOT Riprap Class in English Units

*** For high velocity channels, engineering calculations are to be submitted to the District or City for review.

2.4 Outfall Protection

Outfalls will be designed to prevent scouring at the outfall discharge and provide velocity reduction prior to discharge to the receiving channel. Where rip rap protection is specified, rip rap protection shall be placed over a filter fabric base or a minimum 6" thick gravel base. The following provides additional design guidance in assisting the design Engineer, however, the design Engineer shall be responsible for the final design.

ROCK PROTECTION AT OUTFALLS

Discharge Velocity at Design Flow (fps)			REQUIRED PROTECTION				
			Minimum Dimensions				
			Type	Thickness	Width	Length	Height
0	to	5	ODOT Class 50** Riprap	1.5 ft.	Diameter + 6 ft.	8 ft. or 4x Dia., whichever is greater	Crown + 1 ft.
5	to	10	ODOT Class 200**	2.5 ft.	Diameter + 6 ft. or 3x Dia. Which-ever is greater	12 ft. or 4 x Dia., whichever is greater	Crown + 1 ft.
10	to	20	Designed System*	As required	As required	As required	Crown +1 ft.
20		NA	Engineered Energy Dissipater Required				

* For high velocity outfalls, engineering calculations are to be submitted to the District or City for review.

** ODOT Riprap Class in English Units

2.5 Culvert Design

Culverts provide for passage of water under or through obstructions placed across streams and drainageways. Culverts shall be designed to pass the required flows without compromising public safety or causing new or additional flooding.

For pipe systems or culverts that convey flows from or through sensitive areas, a local representative of Oregon Department of Fish and Wildlife (ODFW) or other applicable state or federal agency should be contacted to determine if fish passage is required and to identify site specific design criteria. Additionally, ODFW may require fish passage accommodations on any stream that has a history or the potential for fish production.

3.0 DRAINAGE REPORT

- a. The Drainage Report shall be on 8-1/2" x 11" paper and maps shall be folded to 8-1/2" x 11" size unless another format is approved prior to submittal.
- b. The Drainage Report shall be prepared by and bear the seal and original signature of a Professional Engineer registered in the State of Oregon and shall contain the following information:
 - 1) Cover Sheet, including the project name, land use authority case file number, proponent's name, address and telephone number, Project Engineer, and date of submittal.
 - 2) Table of Contents, with the page numbers for each section of the report, including exhibits, appendices, and attachments.
 - 3) Vicinity Map.
 - 4) Project Description: Describe the type of permit(s) for which the proponent is applying, the size and location of the project site, address or parcel number and legal description of the property, property zoning. Also describe other permits required (e.g. Corps of Engineers 404 Fill Permit, etc). Describe the project, including proposed land use, proposed site improvements, proposed construction of impervious surfaces, proposed landscaping, and special circumstances.
 - 5) Existing Conditions:
 - a) Describe existing site conditions and relevant hydrological conditions including but not limited to:
 - (1) Project site topography;
 - (2) Land cover and land use;
 - (3) Abutting property land cover and land use;
 - (4) Offsite drainage to the property;
 - (5) Natural and constructed channels;
 - (6) Sensitive areas, wetlands, creeks, ravines, gullies, steep slopes, springs and other environmentally sensitive areas on or adjacent to the project site.

- b) General soils conditions present within the project site, using SCS soil designations.
- c) Points of discharge for existing drainage from the project site.
- d) Include references to relevant reports such as basin plans, flood studies, groundwater studies, wetland designation, watershed plans, subbasin master plans, sensitive area designation, environmental impact statements, water quality reports, or other relevant documents. Where such reports impose additional conditions on the Proponent, those conditions shall be included in the report.
- e) Soils Report(s), where applicable.
- f) Hydrologic Analysis
- g) Basin Map(s), showing boundaries of project, any offsite contributing drainage basins, onsite drainage basins, approximate locations of all major drainage structures within the basins, and depicting the course of stormwater originating from the subject property and extending all the way to the closest receiving body of water. Reference the source of the topographic base map (e.g. USGS), the scale of the map, and include a north arrow.
- h) Drainage Basin Description: Describe the drainage basin(s) to which the project site contributes runoff, and identify the receiving waters for each of these drainage basins.
- i) Developed Site Drainage Conditions: Describe the land cover resulting from the proposed project; describe the potential stormwater quantity and quality impacts resulting from the proposed project; describe the proposal for the collection and conveyance of site runoff from the project site, for the control of any increase in stormwater quantity resulting from the project, and for the control of stormwater quality.
- j) Description of upstream basins, identifying any sources of runoff to the project site. This should be based on field investigation. Any existing drainage or erosion issues upstream that may have an impact on the proposed development should be noted.
- k) Downstream analysis
- l) Hydraulic Design Computations, supporting the design of all proposed stormwater conveyance, quantity and quality control facilities, and verifying the capacity of existing and proposed drainage facilities.

These computations may include capacity and backwater analysis required either as part of the proposed drainage design or as part of the downstream drainage investigation, and flood routing computations required for the design of detention/retention storage facilities, for wetland impact analysis, or for floodplain analysis. A description on how the stormwater system will function during the water quality storm, 2-year storm, 25-year storm and the 100-year storm shall also be included.

- m) Maintenance and Operation Manual: Required for privately owned and maintained stormwater quantity and quality control facilities. This manual will be an attachment to the maintenance covenant.
- n) Appendices: Shall include technical information as necessary.

4.0 DRAINAGE PLANS

- a. It is the responsibility of the Engineer to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of the design guidelines contained in this document.
- b. All Engineered Drainage Plans shall be stamped by a professional engineer registered in the State of Oregon. The Drainage Plan shall contain the following:
 - 1) At least one sheet will contain a plan view of the entire project site. In the event the project site is sufficiently large that detailed drainage plans on any given sheet do not encompass the entire project site, then a sheet containing the plan view of the entire site must serve as an index to subsequent detailed plan sheets.
 - 2) Plans shall include a topographic map showing existing conditions for the site, including:
 - a) Existing topography for the site.
 - b) Adjacent streets, including street names.
 - c) Existing utilities, including franchised utilities located above or below ground and drainage facilities that transport surface water onto, across, or from the project site. Existing drainage pipes, culverts, and channels shall include the invert or flowline elevations.
 - d) Existing environmentally sensitive areas (e.g. ravines, swales, steep slopes, springs, wetlands, creeks, lakes, etc.). For natural drainage

features, show direction of flow, drainage hazard areas, and 100-year flood plain boundary (if applicable).

- 3) Plans for proposed drainage improvements shall include the following:
 - a) Finished grades. Show the extent of cut and fill by existing and proposed contours, profiles or other designations.
 - b) Proposed structures including roads and road improvements, parking surfaces, building footprints, walkways, landscape areas, etc.
 - c) Proposed utilities, showing exact line and grade of all proposed utilities at crossings with the proposed drainage system.
 - d) Setbacks from environmentally sensitive areas.
 - e) Proposed drainage structures, including pipes, open channels, culverts, ponds, vaults, biofiltration swales, infiltration facilities, outfalls, riprap treatment, energy dissipaters, etc.
 - f) Plan and profile of drainage conveyance facilities will include the following information: pipe sizes, pipe types and materials, lengths, slopes, type of structure (e.g. Type 2 CB), location of structures, invert elevations in/out of structures, and top elevations of structures. Notes shall be included referencing details, cross-sections, profiles, etc.
 - g) Indicate any proposed phasing of construction.
- 4) A detailed grading plan will be provided for all open stormwater quantity control and/or quality control facilities. This plan shall include the following:
 - a) Existing ground contours (screened) and proposed ground contours at a minimum of a 2-foot contour interval. Slopes steeper than 6 horizontal to 1 vertical shall be identified.
 - b) Location of top and toe of slope.
 - c) Limits of embankment designed to impound water.
 - d) Location of all drainage structures as well as any other piped utilities in vicinity.
 - e) Flow route of the secondary/emergency overflow system.
 - f) Maintenance access, as applicable.

- 5) A detailed landscape plan will be provided for open stormwater quantity control and/or quality control facilities. This plan shall include the following:
 - a) Final ground contours at a minimum of a 2-foot contour interval.
 - b) Location of top and toe of slope.
 - c) Maximum water surface elevation.
 - d) Location of all drainage structures as well as any other piped utilities in vicinity (screened).
 - e) Limits of areas to receive amended topsoil.
- 6) Cross sections shall be provided for at least the following:
 - a) Detention/retention ponds (including parking lot ponds and other multi-use facilities), wet ponds and sediment ponds. This cross section(s) shall graphically illustrate:
 - (1) The design maximum water surface for the 2-year and 25-year design storms.
 - (2) The proposed dead storage water surface (as applicable).
 - (3) Pavement section or amended soil section as applicable.
 - b) Proposed ditches and swales, including vegetated swales.

**APPENDIX B:
WATER QUALITY & QUANTITY
FACILITY DESIGN**

1.0 GENERAL REQUIREMENTS FOR WATER QUALITY AND QUANTITY FACILITIES

1.1 Erosion Protection

- a. Inlets to water quality and quantity facilities shall be protected from erosive flows through the use of an energy dissipater or rip rap stilling basin of appropriate size based on flow velocities. Flow shall be evenly distributed across the treatment area.
- b. All exposed areas of water quality and quantity facilities shall be protected using coconut or jute matting. Coconut matting or high density jute matting (Geojute Plus or approved equal) shall be used in the treatment area of swales and below the WQV levels of ponds. Low density jute matting (Econojute or approved equal) may be used on all other zones.

1.2 Vegetation

- a. Vegetation shall be in accordance with the Appendix D: Landscape Requirements.
- b. No invasive species shall be planted or permitted to remain within the facility which may affect its function, including, but not limited to the following:
 - 1. Himalayan blackberry (*Rubus discolor*)
 - 2. Reed canarygrass (*Phalaris arundinacea*)
 - 3. Teasel (*Dipsacus fullonum*)
 - 4. English Ivy (*Hedra helix*)
 - 5. Nightshade (*Solanum* sp.)
 - 6. Clematis (*Clematis ligusticifolia* and *C. vitabla*)
 - 7. Cattail (*Typhus latifolia*)
 - 8. Thistle (*Cirsium arvense* and *C. vulgare*)
 - 9. Scotch Broom (*Cytisus scoparius*)

1.3 Fencing

- a. Delineation fencing shall be required around the facility and/or the tract containing the facility. Unless otherwise approved by the District, the District shall require a 4-foot high, vinyl-clad chain link fence conforming to CWS Standard Drawing No. 1005.
- b. The fence shall include a 12-foot wide lockable gate for maintenance access conforming to CWS Standard Drawing No. 1005.

1.4 Access

a. General Access Requirement

Access roads shall be provided for maintenance of all water quality and quantity facilities. The following criteria are considered to be the minimum required for facilities maintained by the District. Other permitting jurisdictions may have more restrictive requirements. If the design Engineer anticipates that any of the requirements will not be met due to the configuration of the proposed development, the design Engineer is advised to meet with District staff to gain approval for the deviation prior to submittal.

b. Standard Road Design

- 1) The road section shall be three (3) inches of class "C" asphaltic concrete; over two (2) inches of $\frac{3}{4}$ "-0" compacted crushed rock; over six (6) inches of $1\frac{1}{2}$ "-0" compacted crushed rock; over subgrade compacted to 95-percent AASHTO T-99; or, the design engineer may submit an alternate design certified as capable of supporting a 30-ton maintenance vehicle in all weather conditions.
- 2) Strengthened sidewalk sections shall be used where maintenance vehicles will cross.
- 3) Maximum grade shall be 10-percent with a maximum 3-percent cross-slope.
- 4) Minimum width shall be 12 feet on straight runs and 15 feet on curves.
- 5) Curves shall have a minimum 40-foot interior radius.

- 6) Access shall extend to within 10-feet of the center of all structures unless otherwise approved by the District/City.
- 7) A curb or other delineator shall be provided at the edge of the road unless otherwise approved.
- 8) The minimum side slope for road embankments shall be 2:1.
- 9) A vehicle turnaround shall be provided when the access road exceed 40' in length.

c. Alternate Access Road

An alternate access road design meeting the requirements of this section may be approved by the District for facilities in which access is required for general maintenance and long term care of the facility, but where there is no structure, as determined by the District, requiring regular maintenance.

- 1) The road section shall meet the requirements of 1.4.b.1) or an alternate section certified as capable of supporting AASHTO HS-20 loading.
- 2) As an alternative to the requirements of 1.4.c.1), a concrete grid paver surface may be constructed by removing all unsuitable material, laying a geotextile fabric over the native soil, placing pavers, filling the honeycombs/grids with soil, and planting appropriate grasses.
- 3) Strengthened sidewalk sections shall be required.
- 4) Maximum grade shall be 20-percent with a maximum 3-percent cross-slope.
- 5) Minimum finished width shall be 12 feet.
- 6) A curb or other delineator shall be provided at the edge of the road unless otherwise approved.
- 7) The minimum side slope for road embankments shall be 2:1.

- 8) A vehicle turnaround shall be provided when the access road exceed 40' in length.

2.0 WATER QUALITY FACILITY DESIGN

This section presents methodology for designing water quality facilities.

2.1 Water Quality Volumes and Flows

(Reproduced from Appendix A: Hydrology and Hydraulics; Section 1)

The water quality storm is the storm required by regulations to be treated. The storm defines both the volume and rate of runoff.

- a. Water Quality Storm: Total precipitation of 0.36 inches falling in 4 hours with a storm return period of 96 hours.
- b. Water quality volume (WQV) is the volume of water that is produced by the water quality storm.
- c. Water Quality Volume (WQV): 0.36-inches over 100-percent of the new impervious area.

$$\text{Water Quality Volume (cf)} = \frac{0.36(\text{in}) \times \text{Area (sf)}}{12 (\text{in/ft})}$$

- d. Water Quality Flow (WQF): The average design flow anticipated from the water quality storm.

$$\text{Water Quality Flow (cfs)} = \frac{\text{Water Quality Volume (cf)}}{14,400 \text{ Sec}}$$

Or

$$\text{Water Quality Flow (cfs)} = \frac{0.36(\text{in}) \times \text{Area (sf)}}{12(\text{in/ft})(4 \text{ hr})(60 \text{ min/hr})(60 \text{ sec/min})}$$

2.2 Pretreatment

- a. Pretreatment Required

Sheet flow of impervious surfaces into water quality facilities will not be allowed without pretreatment. Incoming flows to the water quality facility must be pretreated using a water quality manhole in accordance with section 2.3 or other pre-treatment method as approved by the District/City. Other methods of pretreatment may include proprietary devices, filter

strip, trapped catch basin, or other methods as approved by the District/City.

b. Proprietary Pre-Treatment Devices

1. The use of proprietary pre-treatment devices are permitted on a case by case basis with approval by the District or City
2. The devices will be sized in accordance with the manufacturer's recommendations; however, the minimum treatment flow must be the water quality flow.
3. Technical submittals from the manufacturer are required, including hydraulic design criteria, particulate removal efficiency, and maintenance requirements and schedule.

2.3 Water Quality Manholes

a. Hydraulic Criteria:

1. Minimum Design Flow: Water Quality Flow
2. Upstream flow splitter may be used to bypass conveyance flows in excess of the Water Quality flow.

b. Design Criteria:

1. Shall conform to CWS Standard Drawing No. 515 or an equivalent detail approved by the District/City.
2. Minimum Manhole Diameter: 60-inch
3. Maximum size of incoming pipe: 18-inch
4. Sump Depth: No deeper than 5 feet from invert out to bottom of sump
5. Volume of sump: 20 cubic feet/ 1.0-cfs of flow into the water quality manhole, up to the 25-year flow. Flow calculations shall include the effect of an upstream flow splitter.
6. Maintain a 3-foot clear access zone between the inside structure wall and the interior outlet structure.
7. Orient access to structure in a clear zone.

2.4 Walls in Water Quality Facilities

- a. Walls are not allowed in the treatment areas of any water quality facility.

- b. Walls that are 4 feet or higher or that are periodically inundated must meet all of the following criteria:
 - 1) Be approved by a licensed structural or geotechnical engineer;
 - 2) The District shall not have maintenance responsibility for the wall. The party responsible for maintenance of the walls within the tract shall be clearly documented on the plat or in alternate form as approved by the District.

3.0 WATER QUALITY TREATMENT FACILITIES

3.1 Vegetated Swale

- a. Hydraulic Design Criteria:
 - 1. Design Flow: Water Quality Flow
 - 2. Minimum Hydraulic Residence Time: 9 minutes
 - 3. Maximum Water Design Depth: 0.5-feet
 - 4. Minimum Freeboard: 1.0-foot (for facilities not protected from high flows)
 - 5. Manning "n" Value: 0.24
 - 6. Maximum Velocity: 2.0-fps based on 25-year flow

- b. Design Criteria:
 - 1. Provide an energy dissipater at the entrance to swale, with a minimum length of 4-feet. It will be designed to reduce velocities and spread the flow across the treatment cross section.
 - 2. The use of intermediate flow spreaders maybe required.
 - 3. Minimum Length: 100-feet
 - 4. Minimum Slope: 0.5-percent
 - 5. Minimum Bottom Width: 2-foot
 - 6. Maximum Treatment Depth (measured from top of gravel): 0.5-feet
 - 7. Maximum Side Slope:
 - a) In Treatment Area: 4H:1V
 - b) Above Treatment Area: 2.5H:1V
 - 8. The treatment area shall have 2"-3/4" river run rock placed 2.5 to 3 inches deep on high density jute or coconut matting over 12 inches of topsoil or base stabilization method as approved by the

District/City. Extend river rock, topsoil, and high density jute or coconut matting to top of treatment area (or WQV level). Extend topsoil and low density jute matting to the edge of water quality tract or easement area.

9. Provide an approved outlet structure for all flows.
10. Where swales wrap 180-degrees forming parallel channels, freeboard must be provided between each of the parallel channels. A 1-foot (above ground surface) wall may be used above the treatment area to provide freeboard while enabling a narrower system. As an alternative, a soil-based berm may be used. The berm shall have a minimum top width of 1 foot and 2.5:1 side slopes.
11. Where swales are designed with ditch inlets and outlet structures and design of maintenance access to such structures may be difficult due to swale location, swales may be designed as flow-through facilities with unsumped structures. Maintenance access to one end of the facility will still be required.

3.2 Extended Dry Basin

a. Hydraulic Design Criteria:

1. Permanent Pool Depth: 0.4-feet
2. Permanent pool is to cover the entire bottom of the basin.
3. Minimum Water Quality Detention Volume: 1.0 x Water Quality Volume (WQV)
4. Water Quality Drawdown Time: 48 hours
5. Orifice Size: USE: $D = 24 * [(Q / (C[2gH]^{0.5}) / \pi)]^{0.5}$
Where: D (in) = diameter of orifice
 Q (cfs) = WQV (cf) / (48*60*60)
 $C = 0.62$
 H (ft) = $2/3$ x temporary detention height to centerline of orifice.
6. Maximum Depth of Water Quality Pool (not including Permanent Pool): 4-feet or as limited by issuing jurisdiction.
7. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway to be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.

b. Design Criteria:

1. Minimum of 2 cells, with the first cell (forebay) at least 10% of surface area. The forebay shall also constitute 20-percent of the treatment volume. Where space limits multi-cell design, use one cell with a forebay at the inlet to settle sediments and distribute flow across the wet pond.
2. Inlet and outlet structures shall be designed to avoid direct flow between structures without receiving treatment (i.e. short circuiting of flow).
3. Minimum Bottom Width: 4-feet
4. Maximum Side Slopes in Basin Treatment Area: 3H:1V
5. Minimum Freeboard: 1-foot from 25-year design water surface elevation.
6. The treatment area shall have high density jute or coconut matting over 12 inches of topsoil or base stabilization method as approved by the District/City. If required by the District, 2"-3/4" river run rock shall be placed 2.5 to 3 inches deep in areas where sustained flow is anticipated to occur. Extend river rock (if required), topsoil, and high density jute or coconut matting to top of treatment area (or WQV level). Extend topsoil and low density jute matting to the edge of water quality tract or easement area
7. Provide an approved outlet structure for all flows.
8. The Engineer shall certify that the pond storm sewer design is in compliance with Chapter 3 of this Resolution and Order and that at normal design water surface that the upstream storm sewer will not be in a surcharged condition for longer than 24 hours

3.3 Constructed Water Quality Wetland

a. Hydraulic Design Criteria:

1. Permanent Pool Volume: 0.55 x Water Quality Volume (WQV)
2. Water Quality Detention Volume: 1.0 x Water Quality Volume (WQV)
3. Water Quality Drawdown Time: 48 hours
4. Orifice Size: USE: $D = 24 * [(Q / (C[2gH]^{0.5})) / \pi]^{0.5}$

Where: D (in) = diameter of orifice

Q (cfs) = WQV (cf) / (48*60*60)

$C = 0.62$

$$H(ft) = 2/3 \times \text{temporary detention height to centerline of orifice.}$$

5. Maximum Depth of Permanent Pool: 2.5-feet or as limited by issuing jurisdiction
6. Maximum velocity through the wetland should average less than 0.01-fps for the water quality flow. Design should distribute flows uniformly across the wetland.
7. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway to be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.
8. Provide for a basin de-watering system with a 24-hour maximum drawdown time.

b. Design Criteria:

1. Minimum of 2 cells, with the first cell (forebay) at least 10% of surface area. The forebay shall also constitute 20-percent of the treatment volume. Where space limits multi-cell design, use one cell with a forebay at the inlet to settle sediments and distribute flow across the wet pond.
2. Permanent pool depth to be spatially varied throughout wetland.
3. Provide a perimeter zone 10 to 20-feet wide, which is inundated during storm events.
4. Maximum Side Slopes for Wetland Planting: 5H:1V
5. Maximum Side Slopes for Non-Wetland Planting: 3H:1V
6. Overexcavate by a minimum of 20-percent to allow for sediment deposition.
7. Minimum Freeboard: 1-foot from 25-year design water surface elevation.
8. Provide an approved outlet structure for all flows.

3.4 Other Water Quality Treatment Facilities

The use of other forms of water quality treatment is allowed with the approval of the District or City. However, the applicant must provide evidence of the ability of the facility to meet the District's performance criteria and long term maintenance requirements.

Grass swales will not be allowed.

4.0 WATER QUANTITY FACILITY DESIGN

4.1 Hydraulic Design Criteria:

- a. Detention design shall be assessed by dynamic flow routing through the basin. Documentation of the proposed design shall be included in the drainage report. Acceptable analysis programs include:
 1. HYD;
 2. HEC-1;
 3. HEC-HMS;
 4. SWMM;
 5. HYDRA;
 6. Others as approved.
- b. Peak runoff rates shall not exceed pre-development rates for the specific range of storms.
- c. A pond overflow system shall provide for discharge of the design storm event without overtopping the pond embankment or exceeding the capacity of the emergency spillway. Vortex valve discharge control should be considered to optimize effective pond volume.
- d. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway to be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.

4.2 Design Criteria:

- a. The facility can be a combined water quality and quantity facility provided it meets all relevant criteria.
- b. Interior side slopes up to the Maximum Water Surface: 3H:1V
- c. If interior slopes need to be mowed – maximum side slope: 4H:1V
- d. Maximum Exterior Side Slopes: 2H:1V, unless analyzed for stability by a geotechnical engineer.
- e. Over excavate by a minimum of 20-percent to allow for sediment deposition.
- f. Minimum Freeboard: 1-foot from 25-year design water surface elevation.
- g. Provide an approved outlet structure for all flows.
- h. Certain situations require use of multiple orifice plates to achieve desired outflow rates. Standard Detail No. 544 provides an alternative second structure to Standard Detail No. 545.

4.3 Walls in Water Quantity Facilities

- a. Retaining walls may serve as pond walls if the design is prepared and stamped by a registered professional engineer and a fence is provided along the top of the wall. At least 25% of the pond perimeter will be vegetated to a maximum side slope of 3:1.
- b. Walls that are 4 feet or higher must meet all of the following criteria:
 - 1) Be approved by a licensed structural or geotechnical engineer;
 - 2) The District shall not have maintenance responsibility for the wall. The party responsible for maintenance of the walls within the water quantity tract or easement shall be clearly documented on the plat or in alternate form as approved by the District.

**APPENDIX C:
NATURAL RESOURCE ASSESSMENTS**

1.0 INTRODUCTION

This Appendix presents methodologies for determining the location, size, and condition of Sensitive Areas, Vegetated Corridors, and steep slopes in project areas, as well as the definitions and data required for these determinations. The most current versions of the following maps shall be a reference for performing the assessment and analysis.

- 1) Clean Water Services Prescreen Maps
- 2) The National Wetlands Inventory Maps
- 3) District Stream and Drainage Maps
- 4) Locally adopted studies or maps, including but not limited to Local Wetland Inventory maps, NRCS Soil Survey Map

2.0 PERSONS QUALIFIED TO PERFORM ASSESSMENTS

- a. The property owner or an authorized representative of the property owner may complete the Sensitive Area Assessment and certification.
- b. Sensitive Area Assessments should be conducted by a professional familiar with wetland and other natural resource assessments.
- c. The Simplified Site Assessment outlined in Section 4.1 need not be professionally prepared, but should accurately and clearly show the required information.
- d. The District may reject any Sensitive Area Assessment or Simplified Site Assessment that does not meet generally accepted standards of quality.
- e. The geotechnical analysis, if required, shall be conducted by a professional engineering geologist or geotechnical engineer who will stamp the required report.

3.0 SCOPE OF ASSESSMENT

- a. Sensitive Areas and their Vegetated Corridors generally do not follow property boundaries. To ensure that the Sensitive Areas are provided with proper protections, the assessment requires investigation extending 200 feet onto the adjoining properties.

- b. The applicant shall attempt to gain site access to adjacent properties from the property owner or an authorized representative of the property owner. If property owner/authorized representative denies access the applicant shall use off-site delineation methods including use of mapping information, aerial photographs for the area, and visual observation from the property boundary to perform the assessment.

4.0 ASSESSMENT METHOD

4.1 Simplified Site Assessment Method

- a. The Simplified Site Assessment Method applies only to development which is not likely to adversely impact the Water Quality Sensitive Area and which meets all of the following criteria:
 - 1. Adds less than 500 square feet of impervious surface;
 - 2. Does not encroach closer to the Sensitive Area than existing development on the property; and
 - 3. Is not located on a slope greater than 25%.
- b. Prior to submitting a land use application or obtaining a building permit, the applicant shall submit the following information to the District for review.
 - 1. Written description of the site and proposed activity, including:
 - a. Landscape setting, topography, land uses and site alterations
 - b. Description of proposed development activity
 - c. General description of the Sensitive Area and Vegetated Corridor
 - 2. Site plan of the entire property, including the following:
 - a. Property lines and dimensions
 - b. Location of proposed development activity
 - c. Existing and proposed conditions for property and surrounding area within 200'
 - d. Location and dimensions of roads, driveways, utilities, parking areas, and building footprints
 - e. Location and dimensions of yards and/or cultivated areas
 - f. Locations of existing Sensitive Areas (streams, ponds, wetlands, etc.), Storm Water Infrastructure and drainage ditches

- g. Locations, boundaries, and conditions of the Vegetated Corridors including plant communities, contours, data points and notation of slopes greater than 25%
 - h. Site plan shall be at a scale of one inch equals 50 feet or less (1"=50')
- 3. Photographs of the site, labeled and keyed to the site plan.
 - 4. Sensitive Area Certification Form

4.2 Standard Site Assessment Method

- a. The Standard Site Assessment Method shall be used for development activities not meeting the criteria of 4.1.a.
- b. **Step 1:** Conduct a reconnaissance of the project area and complete the Sensitive Area Certification Form.
 - 1. Determine the presence or absence of Water Quality Sensitive Areas on site or within 200 feet on adjacent property as defined in Chapter 3 of CWS' Design and Construction Standards.
 - 2. If no Water Quality Sensitive Areas are discovered, then submit Sensitive Areas Certification Form along with supporting documentation of existing conditions.
 - 3. If Sensitive Areas are found, continue to Step 2.
- c. **Step 2:** Delineate the boundaries of the Sensitive Area.
 - 1. Wetlands:
 - a) Delineate boundaries using the methods described in the 1987 US Army Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1 from the Waterways Experiment Station is available at:
<http://www.wes.army.mil/el/wetlands/pdfs/wlman87.pdf>
 - b) Survey and map all wetland boundaries on the site base map.

2. Intermittent and/or perennial streams:

a) Identify whether the stream is perennial or intermittent, as defined in Chapter 1. Samples to identify intermittent flow shall be representative of the project reach. Streams are considered perennial until proven intermittent with adequate research and field documentation (photos, field data), following District methodology as outlined below. Applicants are advised to notify the District before conducting intermittent stream determinations. The District will attempt to provide assistance in this process for verification and will continually update the District Intermittent Streams Maps.

Once a stream has been determined to be intermittent, the District shall add the information to the Intermittent Stream Map. Stream segments upstream of an intermittent determination shall be assumed and mapped to be intermittent. The District reserves the right to request site specific information to field verify status, and update Intermittent Stream maps as appropriate.

Field investigation for intermittent stream determinations is most appropriately done during the dry season, i.e. July 1- October 30. If the applicant attempts to make a determination of intermittence during the wet season, the applicant should consider all other available data (historic photos, data, reports, eyewitness accounts, etc.). The District shall review the available data and, if approved, the intermittent determination shall be considered preliminary until status can be definitively confirmed through one of the field methodologies described below.

A stream shall be determined to be intermittent through one of the following methods:

Method 1

The stream channel is dry (without visible flow or standing water) for a period of 30 consecutive days during a year with wet to average precipitation patterns¹. This method requires a minimum of two samples per 100 feet of stream length, collected at the beginning and end of the 30 day period, with supporting data (including maps with photos keyed to each sample location), indicating that the stream is dry. During a year with a dry precipitation pattern, all sampling must be completed prior to August 15.

¹ See Table 1: Precipitation for Use in Determining Perennial and Intermittent Flow Status.

If standing water is present at the first site visit, Method 2 shall be used, or the applicant must wait until the project reach is completely dry to start the 30 day sampling period.

Method 2

The channel must not have saturated² soil in the upper 12 inches, during a year with wet to average precipitation patterns. This method requires representative samples (one per 100 feet of stream length) on only one date. Samples shall include supporting data (including soil texture, level of saturation, and maps with photos keyed to each sample location). During a year with a dry precipitation pattern, all sampling must be completed prior to August 15.

b) For all intermittent and/or perennial streams with defined channels, delineate Sensitive Area boundaries by identifying the top of bank of the defined channel, or the water surface elevation of a 2-year, 24-hour design storm event.

c) For all streams without defined channels, delineate Sensitive Area boundaries by identifying the surface elevation of a 2-year 24-hour design storm event. If determining the surface elevation of a 2-year, 24-hour design storm event is not possible, then the outside edge of the stream Sensitive Area is determined by identifying the areal extent of:

- 1) Soil saturation within the upper twelve inches of the surface;
- 2) Water marks on fixed objects (vegetation, buildings, etc.);
- 3) Drift lines (deposited waterborne twigs, litter, etc.); or;
- 4) Waterborne sediment deposits on the soil surface or fixed objects (vegetation, buildings, etc.);
- 5) Use the indicator that provides the greatest areal cover.

d) For streams draining 10 to 50 acres without a defined channel, and where there are no other Sensitive Areas such as

² Saturated: a condition in which all voids (pores) between soil particles are filled with water.

wetlands, the edge of the Sensitive Area shall be the centerline of the natural drainage swale.

Table 1: Precipitation for Use in Determining Perennial and Intermittent Flow Status

Portland Airport	Average Monthly	10th Percentile (Dry Year)	90th Percentile (Wet Year)
JAN	5.4	2.0	8.5
FEB	4.3	1.7	7.7
MAR	3.7	1.9	5.6
APR	2.4	1.0	3.8
MAY	2.2	0.9	3.7
JUN	1.5	0.4	2.8
JUL	0.6	0.0	1.2
AUG	0.9	0.0	2.1
SEP	1.6	0.1	3.5
OCT	3.1	1.2	5.4
NOV	5.5	2.2	9.3
DEC	5.9	2.6	9.4
ANNUAL	36.9	29.9	43.9

Precipitation values from the National Weather Service web page. Daily and monthly data are available at <http://www.wrh.noaa.gov/Portland/climate/>

- 10th and 90th percentile are calculated using statistical analysis on all historical data available for the gage site at the Portland Airport (1938 - 2001). If other long-term rain data is used, provide location and statistical analysis with submittal

To determine status of the precipitation levels, review the previous Water Year (October 1 – September 30) to date. For determinations conducted during the month of October, use the previous complete Water Year to determine precipitation levels.

2. Springs:

- a) For springs with defined channels, delineate Sensitive Area boundaries by identifying the top of the bank of the defined channel. Determine the outside edge of the spring emergence by the extent of:
 - 1) Soil saturation within the upper twelve inches of the surface;

- 2) Water marks on fixed objects (vegetation, buildings, etc.);
- 3) Drift lines (deposited waterborne twigs, litter, etc.); or
- 4) Waterborne sediment deposits on the soil surface or fixed objects (vegetation, buildings, etc.);
- 5) Use the indicator that provides the greatest areal cover.

b) Survey and map all Sensitive Area boundaries on site base map.

3. Natural lakes, ponds, or in-stream impoundments:

a) Delineate the outside edge of the Sensitive Area boundary by identifying the areal extent of:

- 1) Shoreline vegetation;
- 2) Water marks on fixed objects (vegetation, structures, etc.);
- 3) Drift lines (deposited waterborne twigs, litter, etc.); or
- 4) Waterborne sediment deposits on the soil surface or fixed objects (vegetation, buildings, etc.);
- 5) Use the indicator that provides the greatest areal cover.

b) Survey and map all Sensitive Area boundaries on site base map.

d. **Step 3:** Determine the Vegetated Corridor width for each Sensitive Area identified.

1. Follow procedures outlined in Chapter 3 of the Standards for determining Vegetated Corridor width.

2. Stake, survey, and map the boundaries of the Sensitive Areas and the Vegetated Corridors on the project site and adjacent properties within 200' of the property line on the base map.
- e. **Step 4: Determine the existing Vegetated Corridor condition.**
1. Identify the plant community types present in Vegetated Corridor.
 - a) Traverse the Vegetated Corridor in order to determine the number and area covered by each plant community present. A plant community is defined as a grouping of plants that often occur together growing in a uniform habitat.
 - b) Sketch the location of each plant community on a base map.
 2. Select representative sample points.
 - a) A representative sample point is an area within a plant community in which the visually determined characteristics best represent the plant community as a whole.
 - b) Mark the location of the sample point(s) on the base map.
 - c) Establish at least one sample point per acre per community type. All communities must be sampled.
 3. Characterize each plant community type.
 - a) At the sample point, visually determine and document the area covered by all species providing greater than 5 percent cover within the plot boundary.
 - b) Use a 10-foot radius plot for herbs (non-woody vegetation) and a 30-foot radius plot for woody vegetation.
 - c) Plot boundaries may be adjusted to ensure that only one plant community is represented in a plot.

4. Determine cover by native species, invasive species, and noxious species.
 - a) For each community type, determine the cover provided by both native species and by invasive species and noxious species.
 - b) Average the cover estimates for communities with more than one sample plot.
 - c) Native species as listed in the most current version of Metro or local Native Plant List, whichever is more comprehensive.
 - d) Noxious species are those found in the most current version of Oregon Department of Agriculture Noxious Weed List and Portland Plant List.
 - e) Invasive species are limited to Himalayan or evergreen blackberry (*Rubus discolor, lacinatus*), reed canarygrass (*Phalaris arundinacea*), teasel (*Dipsacus fullonum*), Canada or bull thistle (*Cirsium sp.*), Scotch broom (*Cytisus scoparius*), purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Polygonium cuspidatum*), morning glory (*Convolvulus sp.*), giant hogweed (*Heracleum mantegazzianum*), English ivy (*Hedra helix*), nightshade (*Solanum sp.*), and clematis (*Clematis ligusticifolia* and *C. vitiflora*)
5. Determine existing Vegetated Corridor condition for each plant community.

For each community determine if the Vegetated Corridor within that community is in Good, Marginal, or Degraded Condition as per the Standards (Chapter 3, Table 3.2).

- b) If more than one condition (good, marginal, or degraded) exists within a Vegetated Corridor, indicate the condition of each plant community within the Vegetated Corridor on the site base map.
- c) Transfer results to base map.
- d) Example of a Vegetated Corridor condition assessment:

A one-acre Vegetated Corridor has two community types: Community A, a Douglas fir forest covering about 90 percent of the corridor; and Community B, a Himalayan blackberry dominated community over the remaining 10 percent, as described in the following table.

Community A (90% of Corridor)	Cover	Community B (10% of Corridor)	Cover
Douglas Fir*	70	Oregon White Oak*	10
Vine Maple*	10	Himalayan Blackberry**	50
Sword Fern*	10	Common Strawberry*	35
English Ivy **	5	Tall Fescue	45
Perennial Ryegrass	20		
% Cover by Natives	90	% Cover by Natives	45
% Tree Canopy	70	% Tree Canopy	10
% Invasive/Noxious	5	% Invasive/Noxious	50

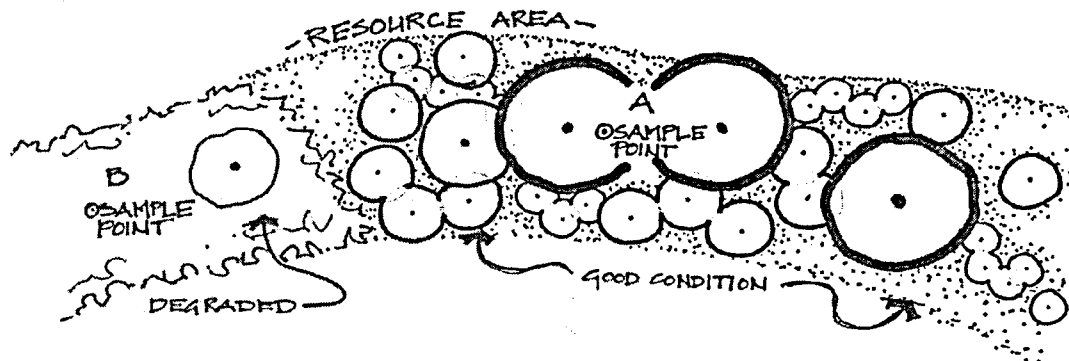
* = Native species ** = Invasive species or noxious weed

▪ Vegetated Corridor Condition Community A:

- 1) Greater than 80 percent cover by native trees, shrubs, and groundcovers;
- 2) Greater than 50 percent tree canopy cover;
- 3) Less than 10 percent cover by invasive species and noxious weeds;
- 4) Vegetated Corridor Condition = Good.

▪ Vegetated Corridor Condition Community B:

- 1) Less than 50 percent cover by native trees, shrubs, and groundcovers;
- 2) Less than 25 percent tree canopy cover;
- 3) Greater than 10 percent cover by invasive species and noxious weeds;
- 4) Vegetated Corridor Condition = Degraded.



f. **Step 5: Additional Assessments**

1. If development is proposed closer than 35' from the break in slope at the top of ravine, a geotechnical analysis is required. The geologist or geotechnical engineer shall provide a stamped report containing:
 - a) Description and map of soil type and erodibility conditions of the slope.
 - b) Documentation of evidence of potential historic slope movement, if any.
 - c) Limits of impact to the slope necessary for it to remain stable.
 - d) Estimation of weight that can be applied to the top of a slope and remain stable.
 - e) Other relevant information deemed appropriate to include.
2. If a Tier 2 Alternatives Analysis is proposed, a functional assessment is required. The report shall be prepared using methodology outlined in Oregon Division of State Lands Hydrogeomorphic (HGM) approach of assessment for wetland and riparian functions.

g. **Step 6: Prepare the Natural Resources Assessments Report**

1. Draft a report documenting the site and adjacent property Sensitive Area, Vegetated Corridor condition, and slope.
2. Include a description of each plant community.
3. Include copies of written data assessment forms for Vegetated Corridor analysis and wetland delineation and show on the base map.
4. Include a base map site plan for the entire property in the report and photos of representative features on site and adjacent property. The site plan shall include the following:
 - a) Property lines and dimensions

- b) Location of proposed development activity
- c) Existing and proposed conditions for property and surrounding area within 200'
- d) Location and dimensions of roads, driveways, utilities, parking areas, and building footprints
- e) Location and dimensions of yards and/or cultivated areas
- f) Locations, boundaries, and conditions of existing Sensitive Areas (streams, ponds, wetlands, etc), Storm Water Infrastructure, and drainage ditches
- g) Locations, boundaries, and conditions of the Vegetated Corridors including plant communities, contours, data points and notation of slopes greater than 25%
- h) Site plan shall be at a scale of one inch equals 50 feet or less (1"=50')

Sensitive Areas Certification Form

Property Owner

Name _____

Address _____

City/State/Zip _____

Telephone _____ Fax _____

E-mail _____

Authorized Agent

Name _____

Address _____

City/State/Zip _____

Telephone _____ Fax _____

E-mail _____

Project Location

Street, road, or other descriptive location _____

Legal Description:

Quarter	Section	Township	Range
In or near (city or town)	County	Tax Map #	Tax Lot #
Waterway	River Mile	Latitude	Longitude

Adjacent Property Information:

Street, road, or other descriptive location _____

Legal Description:

Quarter	Section	Township	Range
In or near (city or town)	County	Tax Map #	Tax Lot #
Waterway	River Mile	Latitude	Longitude

An on-site, Water Quality Sensitive Area reconnaissance was completed on:

Date	By	Title	Company
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A. Existence of Water Quality Sensitive Areas

As defined in CWS's Design and Construction Standards, Water Quality Sensitive Areas:

do do not exist on site (check appropriate box).

do do not exist within 200 feet on adjacent properties, or unable to evaluate adjacent property (check appropriate box).

- If Water Quality Sensitive Areas exist, complete Section B below.
- If Water Quality Sensitive Areas do not exist, skip Section B, sign this form and submit to CWS with plan approval package.

B. Types of Water Quality Sensitive Areas

The type(s) of Water Quality Sensitive Area(s) that occur on site or within 200 feet on adjacent properties are (check all that apply):

wetland(s) spring(s) intermittent stream(s) perennial stream(s) ponds

Sign this form and submit to CWS with plan approval package and one (1) copy of:

- Natural Resources Assessment Report that includes:
 - Wetland Delineation Report per DSL / Corps reporting requirements (if wetlands present).
 - Vegetated Corridor documentation, including a base map and photographs showing the surveyed location of all Sensitive Areas, Vegetated Corridors, and Vegetated Corridor condition.

I certify that I am familiar with the information contained in this document, and to the best of my knowledge and belief, this information is true, complete, and accurate.

Property Owner:

Print/Type Name	Print/Type Title
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Signature	Date
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APPENDIX D: LANDSCAPE REQUIREMENTS

1.0 INTRODUCTION

1.1 Jurisdiction

Clean Water Services (District) recognizes the importance of the water quality Sensitive Areas, Vegetated Corridors, and Storm Water Infrastructure that, along with the Tualatin River, fall under its jurisdiction. To improve water quality and preserve aquatic species, and meet the intent of both the federal Clean Water and the Endangered Species Acts, the District developed the following requirements for landscape management.

Most Sensitive Areas are also regulated by the Division of State Lands (DSL) and the U.S. Army Corps of Engineers (Corps). In the event of permitted mitigation, planting plans for these areas shall follow DSL and Corps guidelines and approved plans. Vegetated Corridors and Storm Water Facilities are regulated by the District and the plans and management strategies for these areas shall follow the steps outlined in this document. Alternative plans and management strategies may be approved by the District.

1.2 Professional Assistance

Revegetation in Sensitive Areas, Vegetated Corridors and Storm Water Infrastructure should facilitate succession toward low maintenance native plant communities. Consultation with a professional landscape architect, ecologist, or horticulturist knowledgeable in native plants is highly recommended when preparing plans. Satisfying the landscaping requirements may require the services of a registered landscape architect. See ORS671.310 through 671.459.

Non-native, invasive plant management and wildlife damage management strategies are provided in Clean Water Services *Integrated Vegetation and Animal Management (IVAM) Guidance*. Especially challenging management situations may require assistance from a landscape maintenance contractor or a wildlife biologist.

2.0 REVEGETATION METHODS

Successful revegetation is critical to the proper function of Sensitive Areas, Vegetated Corridors and Storm Water Infrastructure for the benefit of water quality and quantity management, and aquatic species preservation. This Appendix aids professionals, the development community, and field crews in planning, designing and implementing successful revegetation projects in these areas. This document guides design decisions to promote successful planting efforts, while allowing flexibility to address opportunities and constraints at each

site. When developing revegetation plans, four major components shall be addressed: hydrology, soils, plant materials, and maintenance.

Document the following steps in preparing the landscape plan:

Step 1: Assess Hydrologic and Hydraulic Conditions

- a) Determine the frequency and duration of water inundation (including appropriate elevations) of the revegetation area. Watershed hydrology and hydraulic models for major streams are available from the District. In some cases, current site conditions (i.e. wetland presence) will suffice. For Storm Water Infrastructure, the models used to design and size the facility shall be used to determine frequency, duration and surface water elevations within the facility.
- b) Assign appropriate hydrologic zones to the revegetation area and apply them to the plan. Most project sites include one or more of the following planting zones with respect to hydrology during the growing season:
 - Wet (standing or flowing water/nearly constant saturation; anaerobic soils)
 - Moist (periodically saturated; anaerobic and/or aerobic soils)
 - Dry (infrequent inundation/saturation, if any; aerobic soils)
- c) Identify and map wet, moist and dry planting zones.

Step 2: Assess Soil Conditions and Assign Appropriate Preparation Specifications to Plans

- a) Determine the organic content and non-native, invasive seed bank likely in the soil. For most Storm Water Facilities, the soil is often high in clay, gravel, or minerals devoid of topsoil and organic material, and/or high in non-native, invasive weed content. The conditions in Sensitive Areas and Vegetated Corridors vary greatly.
- b) For upland sites with at least one foot of native topsoil, but containing a non-native, invasive seed bank or plants, remove the undesirable plants, roots, and seeds (*see IVAM Guidance*) prior to planting.
- c) For upland sites with less than one foot of topsoil and invasive, non-native seed bank or plants that have become established, remove the undesirable plants, roots, and seeds (*see IVAM Guidance*) prior to adding topsoil. The sub-grade in these areas shall be tilled to a depth of at least four inches and at least 12 inches of clean compost-amended topsoil shall be added. In the event of floodplain grading, over-excavation of the sub-grade shall occur to ensure that the 12 inches of topsoil can be applied without impacting surface water elevations. The compost-amended topsoil shall have the

following characteristics to ensure a good growing medium for the selected plants:

- Texture – material passes through one-inch screen
 - Fertility – 35% organic matter
- d) For wet areas in Sensitive Areas and Storm Water Infrastructure, the soil conditions shall be hydric or the grading designed to hold sufficient water to promote hydric soil formation. For some bulb and tubers, the addition of organic muck soil will improve plant establishment.
- e) Where necessary for erosion control or organic matter enhancement, additional leaf compost may be placed uniformly on topsoil. (Refer to *Erosion Prevention and Sediment Control Planning and Design Manual, December 2000.*) Other amendments, conditioners, and bio-amendments may be added as needed to support the specified plants or adjust the soil pH. Traditional fertilization techniques (applying N-P-K) are not necessary when using native plants.

Step 3: Identify Plants to be Preserved, Select Revegetation Plant Materials, Quantities, Placement and Assign Planting Zones and Specifications to Plans

- a) Preservation: Every effort shall be made to protect a site's existing native vegetation. Native vegetation along Sensitive Areas and Vegetated Corridors shall be retained to the maximum extent practicable.
- b) Selection: Plant selection shall be from a native species palette and shall consider site soil types, hydrologic conditions, and shade requirements. A detailed list of common native plant community types appropriate for planting Sensitive Areas, Vegetated Corridors and Storm Water Infrastructure is provided in Table 1. Upon approval from the District, limited use of non-invasive non-native plants may be permitted in highly urbanized settings such as regional town centers. Planting restrictions are limited to the following:
- (1) Deep rooting trees and shrubs (e.g. willow) shall not be planted on top of concrete pipes, or within 10 feet of retaining walls, inlet/outlet structures or other culverts; and
 - (2) Large trees or shrubs shall not be planted on berms over four feet tall that impound water. Small trees or shrubs with fibrous root systems may be installed on berms that impound water and that are less than four feet tall.
- c) Quantities: Trees shall be planted at 10 feet on-center; shrubs shall be planted at four feet on-center. See Table 1 for on-center requirements for herbaceous species. The following equations shall be used to calculate planting densities on a per acre basis.

- Total number of trees per acre = area in square feet x 0.01
 - Total number of shrubs per acre = area in square feet x 0.05
 - Groundcover = plant and seed to achieve 100% areal coverage
- d) Placement: Plant placement shall be consistent with the form of the naturally occurring plant community. Trees and shrubs shall be placed in singles or clusters of the same species to provide a natural planting scheme. The grouping size and plant quantity is dependant on the species being planted, their respective sizes, and on the size of the revegetation area. Overseeding of the revegetation area shall occur with native seed mixes appropriate to the plant community and hydrologic zone in which it is being applied (see Table 1: Plant Communities for Revegetation). The plant placement and seeding shall promote maximum vegetative cover to reduce the area available for weed establishment.

Step 4: Determine Plant Installation Requirements and Assign Specifications to Plans

- a) Timing: Plantings shall be installed between February 1 and May 1 or between October 1 and November 15. When plantings must be installed outside these times, additional measures may be needed to ensure survival and shall be specified on the plans.
- b) Erosion Control: Grading, soil preparation, and seeding shall be performed during optimal weather conditions and at low flow levels to minimize sediment impacts. Site disturbance shall be minimized and desirable vegetation retained, where possible. Slopes shall be graded to support the establishment of vegetation. Where seeding is used for erosion control, either Regreen (or its equivalent) or sterile wheat shall be used to stabilize slopes until permanent vegetation is established. Biodegradable fabrics (coir, coconut or approved jute matting (min. 1/4" square holes)) may be used to stabilize slopes and channels. Fabrics such as burlap may also be used to hold plant plugs in place and to discourage floating upon inundation. No plastic mesh that can entangle wildlife shall be permitted. Consult Clean Water Services' *Erosion Prevention and Sediment Control Planning and Design Manual (December 2000)* for additional information.
- c) Mulching: Trees, shrubs, and groundcovers planted in upland areas shall be mulched a minimum of three inches in depth and 18 inches in diameter, to retain moisture and discourage weed growth around newly installed plant material. Appropriate mulches include those made from composted bark or leaves that have not been chemically treated. The use of mulch in frequently inundated areas shall be limited, to avoid any possible water quality impacts including the leaching of tannins and nutrients, and the migration of mulch into waterways.

- d) **Plant Protection from Wildlife:** Depending on site conditions, appropriate measures shall be taken to limit wildlife-related damage (*see IVAM Guidance*).
- e) **Irrigation:** Unless site hydrology is currently adequate, a District/City approved irrigation system or other water practice (i.e., polymer, plus watering) shall be installed and used during the three-year plant establishment period. Watering shall be provided at a rate of at least one inch per week between June 15 and October 15.
- f) **Access:** Maintenance access for plant maintenance shall be provided for Sensitive Areas and Vegetated Corridors via a five-foot easement or shared boundary with Storm Water Infrastructure. Storm Water Infrastructure access requirements are provided in Appendix B: *Water Quality and Quantity Facility Design*.

Step 5: Determine Plant Monitoring and Maintenance Requirements

- a) **Monitoring:** Site visits in the spring and fall will likely be necessary to assess the status of the plantings, irrigation, mulching, etc. and to avoid failure of revegetation effort.
- b) **Weed Control:** The removal of non-native, invasive weeds shall be necessary throughout the maintenance period, or until a healthy stand of desirable vegetation is established (*see IVAM Guidance*).
- c) **Plant Replacement and Preservation:** Installed plants that fail to meet the acceptance criteria (see Chapter 2) shall be replaced during the maintenance period. Prior to replacement, the cause of loss (wildlife damage, poor plant stock, etc.) shall be documented, corrected and the plants replaced.

Step 6: Prepare Construction Documents and Specifications

The construction documents and specifications shall include:

- a) Sensitive Area boundaries and Vegetated Corridor boundaries
- b) Site Preparation plan and specifications, including limits of clearing, existing plants and trees to be preserved, and methods for removal and control of invasive, non-native species, and location and depth of topsoil and or compost to be added to revegetation area
- c) Planting plan and specifications:
 - i. planting table that documents the common name, scientific name, distribution (zone and spacing), condition and size of plantings,
 - ii. installation methods for plant materials,

- iii. mulching,
 - iv. plant tagging for identification,
 - v. plant protection, and
 - vi. seeding methods, rates, and areas
- d) Irrigation plan and specifications, including identification of water source, watering timing and frequency, and maintenance of the system
 - e) Maintenance schedule; including responsible party and contact information, dates of inspection (minimum three per growing season and one prior to onset of growing season) and estimated maintenance schedule (as necessary) over the three year monitoring period
 - f) Access points for installation and maintenance including vehicle access if available
 - g) Standard drawing details (north arrow, scale bar, property boundaries, project name, drawing date, name of designer and property owner).

Table 1: Plant Communities for Revegetation

Plant Communities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	On Center / Seeding Rate ¹	Spacing Format ²
Riparian Forest (RF)								
Red alder (<i>Alnus rubra</i>)	⊙	Tree	Moist	Sun	1 gal	3'	10'	Single
Western red cedar (<i>Thuja plicata</i>)	⊙	Tree	Moist	Shade	2 gal	2'	10'	Single
Western hemlock (<i>Tsuga heterophylla</i>)	⊙	Tree	Moist	Part	2 gal	2'	10'	Single
Red elderberry (<i>Sambucus racemosa</i>)	⊙	Shrub	Moist	Part	1 gal	1.5'	4-5'	Single
Black twinberry (<i>Lonicera involucrata</i>)		Shrub	Moist	Part	1 gal	1.5'	4-5'	Single
Highbush cranberry (<i>Viburnum edule</i>)		Shrub	Moist	Part	1 gal	1.5'	4-5'	Single
Red-osier dogwood (<i>Cornus stoniferia</i>)	⊙	Shrub	Wet	Part	1 gal	2'	4-5'	Cluster
Indian plum (<i>Oemleris cerasiformis</i>)	⊙	Shrub	Moist	Shade	2 gal	2'	4-5'	Cluster
Swamp rose (<i>Rosa pisocarpa</i>)		Shrub	Moist	Part	1 gal	1.5'	4-5'	Cluster
Pacific ninebark (<i>Physocarpus capitatus</i>)		Shrub	Moist	Shade	1 gal	2'	4-5'	Single
Snowberry (<i>Symphoricarpos albus</i>)	⊙	Shrub	Dry	Part	1 gal	1.5'	4-5'	Cluster
Salmonberry (<i>Rubus spectabilis</i>)	⊙	Shrub	Moist	Shade	1 gal	1.5'	4-5'	Cluster
Stinky currant (<i>Ribes viscosissimum</i>)		Shrub	Moist	Part	1 gal	1.5'	4-5'	Single
Maidenhair fern (<i>Adiantum pedatum</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Lady fern (<i>Athyrium filix-femina</i>)		Herb	Moist	Shade	1 gal	na	Variable	Cluster
Skunk cabbage (<i>Lysichiton americanum</i>)		Herb	Wet	Shade	bulbs	na	Variable	Cluster
False lily-of-the-valley (<i>Maianthemum dilatatum</i>)		Herb	Moist	Shade	bulbs, 4"	na	Variable	Cluster
Candy Flower (<i>Claytonia sibirica</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Miners Lettuce (<i>Monita perfoliata</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Stream violet (<i>Viola glabella</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Youth-on-age (<i>Tolmiea menziesii</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Insideout flower (<i>Vancouveria hexandra</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Dewey's sedge (<i>Carex deweyana</i>)		Herb	Dry	Shade	plugs, 4"	4"	Variable	Mass
Hair bentgrass (<i>Agrostis scabra</i>)		Grass	Moist	Part	seed	na	2 lbs pls	Mass
Oregon bentgrass (<i>Agrostis oregonensis</i>)	⊙	Grass	Dry	Part	seed	na	2 lbs pls	Mass
Tall manna-grass (<i>Glyceria elata</i>)	⊙	Grass	Moist	Part	seed	na	8 lbs pls	Mass

Table 1: Plant Communities for Revegetation

Plant Communities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	On Center / Seeding Rate ¹	Spacing Format ²
Upland Forest (UF)								
Red alder (<i>Alnus rubra</i>)	⊙	Tree	Moist	Sun	1 gal	3'	10'	Single
Big leaf maple (<i>Acer macrophyllum</i>)	⊙	Tree	Dry	Sun	2gal	3'	10'	Single
Douglas Fir (<i>Pseudotsuga menziesii</i>)	⊙	Tree	Dry	Sun	2gal	3'	10'	Single
Grand fir (<i>Abies grandis</i>)	⊙	Tree	Dry	Sun	2 gal	2'	10'	Single
Pacific yew (<i>Taxus brevifolia</i>)		Tree	Moist	Shade	2 gal	2'	10'	Single
Cascara (<i>Rhamnus purshiana</i>)		Tree	Dry	Part	2 gal	2'	10'	Single
Pacific dogwood (<i>Cornus nattallii</i>)		Tree	Moist	Shade	1 gal	2'	10'	Single
Bitter cherry (<i>Prunus emarginata</i>)		Tree	Moist	Part	2 gal	2'	10'	Single
Vine Maple (<i>Acer circinatum</i>)	⊙	Tree	Moist	Part	2 gal	2'	4-5'	Single
Oceanspray (<i>Holodiscus discolor</i>)	⊙	Shrub	Dry	Sun	1 gal	1.5'	4-5'	Single
Red elderberry (<i>Sambucus racemosa</i>)	⊙	Shrub	Moist	Part	1 gal	1.5'	4-5'	Single
Red flowering currant (<i>Ribes sanguineum</i>)	⊙	Shrub	Dry	Sun	1 gal	1.5'	4-5'	Cluster
Cascade Oregon Grape (<i>Mahonia nervosa</i>)		Shrub	Moist	Part	1 gal	4"	4-5'	Cluster
Tall Oregon Grape (<i>Mahonia aquifolium</i>)		Shrub	Dry	Sun	1 gal	6"	4-5'	Single
Red huckleberry (<i>Vaccinium parvifolium</i>)		Shrub	Moist	Shade	1 gal	1.5'	4-5'	Cluster
Thimbleberry (<i>Rubus pariflorus</i>)		Shrub	Moist	Shade	1 gal	1.5'	4-5'	Cluster
Snowberry (<i>symphoricarpos albus</i>)	⊙	Shrub	Dry	Part	1 gal	1.5'	4-5'	Cluster
Woods Rose (<i>Rosa woodsii</i>)	⊙	Shrub	Dry	Part	1 gal	1.5'	4-5'	Cluster
Serviceberry (<i>Almelanchier alnifolia</i>)		Shrub	Dry	Part	2 gal	2'	4-5'	Single
Sword fern (<i>Polystichum munitum</i>)		Shrub	Moist	Shade	2 gal	na	4-5'	Cluster
Deer fern (<i>Blechnum spicant</i>)		Herb	Moist	Shade	1 gal	na	Variable	Cluster
Orange honeysuckle (<i>Lonicera ciliosa</i>)		Herb	Moist	Shade	2 gal	na	Variable	Single
Salal (<i>Gaultheria shallon</i>)		Herb	Moist	Part	1 gal	4"	Variable	Cluster
Wood strawberry (<i>Fragaria vesca</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Western trillium (<i>Trillium ovatum</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Saxifrage (<i>Mitella spp</i>)		Herb	Moist	Shade	1 gal	na	Variable	Cluster
Red columbine (<i>Aquilegia formosa</i>)		Herb	Dry	Part	4"	na	Variable	Cluster
Solomon's seal (<i>Solomon smilacina</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Native California brome (<i>Bromus carinatus</i>)	⊙	Grass	Dry	Sun	seed	na	10 lbs pls	Mass
Blue Wildrye (<i>Elymus glaucus</i>)	⊙	Grass	Dry	Part	seed	na	10 lbs pls	Mass

Table 1: Plant Communities for Revegetation

Plant Communities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Depth	Minimum Plant Height	On Center / Seeding Rate ¹	Spacing Format ²
Oak Woodland / Savanna (OW)								
Oregon white oak (<i>Quercus garryana</i>)	⊙	Tree	Dry	Sun	2 gal	2'	10'	Single
Pacific madrone (<i>Arbutus menziesii</i>)	⊙	Tree	Dry	Sun	2 gal	2'	10'	Single
Snowberry (<i>Symphoricarpos albus</i>)	⊙	Shrub	Dry	Part	1 gal	1.5'	4-5'	Cluster
Serviceberry (<i>Amelanchier alnifolia</i>)	⊙	Shrub	Dry	Part	1 gal	2'	4-5'	Single
Oceanspray (<i>Holodiscus discolor</i>)	⊙	Shrub	Dry	Sun	1 gal	1.5'	4-5'	Cluster
Nootka rose (<i>Rosa nutkana</i>)		Shrub	Moist	Sun	1 gal	1.5'	4-5'	Cluster
Cascade Oregon grape (<i>Mahonia nervosa</i>)		Herb	Moist	Part	1 gal	4"	Variable	Cluster
Blue wild-rye (<i>Elymus glaucus</i>)	⊙	Grass	Dry	Part	seed	na	10 lbs pls	Mass
Native California brome (<i>Bromus carinatus</i>)	⊙	Grass	Dry	Sun	seed	na	10 lbs pls	Mass
Ash Forested Wetland (FW)								
Oregon Ash (<i>Fraxinus latifolia</i>)	⊙	Tree	Moist	Part	2 gal	3'	10'	Single
Pacific Ninebark (<i>Physocarpus capitatus</i>)	⊙	Shrub	Moist	Shade	2 gal	2'	4-5'	Single
Red-osier dogwood (<i>Cornus stolonifera</i>)	⊙	Shrub	Wet	Part	1 gal	2'	4-5'	Cluster
Snowberry (<i>Symphoricarpos albus</i>)	⊙	Shrub	Dry	Part	1gal	1.5'	4-5'	Cluster
Slough sedge (<i>Carex obnupta</i>)	⊙	Herb	Moist	Part	plugs	6"	Variable	Mass
Corn lily (<i>Ceratrum californicum</i>)		Herb	Wet	Shade	bulbs	na	Variable	Cluster
Candy flower (<i>Claytonia sibirica</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Miners lettuce (<i>Montia perfoliata</i>)		Herb	Moist	Shade	4"	na	Variable	Cluster
Dewey's sedge (<i>Carex deweyana</i>)		Herb	Dry	Shade	plugs	4"	Variable	Mass
Small fruited bulrush (<i>Scirpus microcarpus</i>)		Herb	Wet	Sun	plugs	4"	Variable	Mass
Tall mannagrass (<i>Glyceria elata</i>)	⊙	Grass	Moist	Shade	seed	na	10 lbs pls	Mass

Table 1: Plant Communities for Revegetation

Plant Communities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting	Minimum Plant Height	On Center / Seeding Rate ¹	Spacing Format ²
Shrub / Scrub Wetland (SS)								
Pacific willow (<i>Salix lasiandra</i>)	⊙	Tree	Wet	Sun	1 gal	3'	10'	Single
Sitka willow (<i>Salix sitchensis</i>)		Tree	Moist	Sun	1 gal	3'	10'	Cluster
Douglas hawthorne (<i>Crataegus douglasii</i>)		Tree	Moist	Part	2 gal	2'	10'	Cluster
Pacific Crabapple (<i>Malus fusca</i>)	⊙	Tree	Moist	Part	2 gal	2'	10'	Cluster
Scouler willow (<i>Salix scouleriana</i>)	⊙	Shrub	Moist	Sun	1 gal	3'	4-5'	Cluster
Red-osier dogwood (<i>Cornus stolonifera</i>)	⊙	Shrub	Wet	Part	1 gal	2'	4-5'	Cluster
Clustered rose (<i>Rosa pisocarpa</i>)		Shrub	Wet	Part	1 gal	1.5'	4-5'	Cluster
Douglas spirea (<i>Spirea douglasii</i>)	⊙	Shrub	Wet	Sun	1 gal	1.5'	4-5'	Cluster
Nodding beggartick (<i>Bidens cernua</i>)		Herb	Wet	Sun	1 gal	1.5'	Variable	Cluster
Spreading rush (<i>Juncus patens</i>)		Herb	Moist	Part	plugs	6"	Variable	Mass
Western manna-grass (<i>Glyceria occidentalis</i>)	⊙	Grass	Wet	Sun	seed	na	8 lbs pls	Mass
Emergent Marsh (EM)								
Nodding beggartick (<i>Bidens cernua</i>)	⊙	Herb	Moist	Sun	1 gal	1.5'	Variable	Cluster
Hardstem bulrush (<i>Scirpus accutus</i>)		Herb	Wet	Sun	plugs	1.5'	Variable	Cluster
Small-fruited bulrush (<i>Scirpus microcarpus</i>)	⊙	Herb	Wet	Sun	plugs	6"	Variable	Mass
Creeping spike rush (<i>Eleocharis palustris</i>)	⊙	Herb	Wet	Sun	seed, plugs	4"	Variable	Mass
Wapato (<i>Sagittaria latifolia</i>)		Herb	Wet	Sun	bulbs	na	Variable	Cluster
American water plantain (<i>Alisma plantago-aquatica</i>)		Herb	Wet	Sun	bulbs	na	Variable	Cluster
Soft stemmed bulrush (<i>Scirpus taberaemontani</i>)		Herb	Wet	Sun	plugs	1.5'	Variable	Cluster
American brooklime (<i>Veronica americana</i>)		Herb	Wet	Sun	plugs	na	Variable	Cluster
Marsh speedwell (<i>Veronica scutellata</i>)		Herb	Wet	Sun	plugs	na	Variable	Cluster
American sloughgrass (<i>Beckmannia syzigachne</i>)	⊙	Grass	Wet	Sun	seed, plugs	na	16 lbs pls	Mass
Western manna-grass (<i>Glyceria occidentalis</i>)	⊙	Grass	Wet	Sun	seed	na	8 lbs pls	Mass

Table 1: Plant Communities for Revegetation

Plant Communities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	On Center / Seeding Rate ¹	Spacing Format ²
Storm Water Facility (SWF)								
Oregon Ash (<i>Fraxinus latifolia</i>)		Tree	Moist	Part	2 gal	3'	10'	Single
Red alder (<i>Alnus rubra</i>)	⊙	Tree	Moist	Sun	1 gal	3'	10'	Single
Douglas Fir (<i>Pseudotsuga menziesii</i>)	⊙	Tree	Dry	Sun	2gal	3'	10'	Single
Vine Maple (<i>Acer circinatum</i>)	⊙	Tree	Moist	Part	2 gal	2'	4-5'	Single
Pacific willow (<i>Salix lasiandra</i>)		Tree	Wet	Sun	1 gal	3'	10'	Single
Sitka willow (<i>Salix sitchensis</i>)		Tree	Moist	Sun	1 gal	3'	10'	Cluster
Pacific dogwood (<i>Cornus nuttallii</i>)		Tree	Moist	Shade	1 gal	2'	10'	Single
Bitter cherry (<i>Prunus emarginata</i>)		Tree	Moist	Part	2 gal	2'	10'	Single
Scouler willow (<i>Salix scouleriana</i>)		Shrub	Moist	Sun	1 gal	3'	4-5'	Cluster
Red-osier dogwood (<i>Cornus stolonifera</i>)	⊙	Shrub	Wet	Part	1 gal	2'	4-5'	Cluster
Pacific ninebark (<i>Physocarpus capitatus</i>)		Shrub	Moist	Shade	1 gal	2'	4-5'	Single
Oceanspray (<i>Holodiscus discolor</i>)	⊙	Shrub	Dry	Sun	1 gal	1.5'	4-5'	Single
Serviceberry (<i>Amelanchier alnifolia</i>)	⊙	Shrub	Dry	Part	1 gal	2'	4-5'	Single
Nootka rose (<i>Rosa nutkana</i>)		Shrub	Moist	Sun	1 gal	1.5'	4-5'	Cluster
Snowberry (<i>Symphoricarpos albus</i>)	⊙	Shrub	Dry	Part	1gal	1.5'	4-5'	Cluster
Native rose (<i>Rosa pisocarpa</i> or <i>gymnocarpa</i>)		Shrub	Wet	Part	1 gal	1.5'	4-5'	Cluster
Douglas spirea (<i>Spirea douglasii</i>)	⊙	Shrub	Wet	Sun	1 gal	1.5'	4-5'	Cluster
Red flowering currant (<i>Ribes sanguineum</i>)	⊙	Shrub	Dry	Sun	1 gal	1.5'	4-5'	Cluster
Nodding beggartick (<i>Bidens cernua</i>)		Herb	Wet	Sun	1 gal	1.5'	Variable	Cluster
Spreading rush (<i>Juncus patens</i>)		Herb	Moist	Part	plugs	6"	Variable	Mass
Small-fruited bulrush (<i>Scirpus microcarpus</i>)		Herb	Wet	Sun	plugs	6"	Variable	Mass
Creeping spike rush (<i>Eleocharis palustris</i>)		Herb	Wet	Sun	seed, plugs	4"	Variable	Mass
Slough sedge (<i>Carex obtusa</i>)	⊙	Herb	Moist	Part	plugs	6"	Variable	Mass
Toad rush (<i>Juncus bufonius</i>)*		Herb	Dry	Sun	seed, plugs	4"	Variable	Mass
Rossi Sedge (<i>Carex rossi</i>)*		Herb	Moist	Sun	plugs	4"	Variable	Mass
NW Native Wildflower mix		Herb	Mix	Sun	seed	na	10 lbs pls	Mass
Oregon Bentgrass (<i>Agrostis oregonensis</i>)*	⊙	Grass	Dry	Sun	seed	na	8 lbs pls	Mass
Idaho bentgrass (<i>Agrostis idahoensis</i>)*		Grass	Dry	Sun	seed	na	8 lbs pls	Mass
Western manna-grass (<i>Glyceria occidentalis</i>)		Grass	Wet	Sun	seed	na	8 lbs pls	Mass

¹ Seeding rate: pure live seed (pls) pounds per acre

Tree spacing = sq footage x 0.01; Shrub spacing = sq footage x 0.05; Groundcover = 100% areal cover.

Square footage is based on the total site or facility size.

² Single= distribute throughout planting area. Cluster = group 3 to 7 plants in same area with herb or grass in between.

Mass = plant densely to form a single stand of that species in a given area. Page 5

**APPENDIX E
STANDARD DETAILS**

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SD-2	020	Precast Concrete Manhole Base
SD-3	030	Precast Rubber Gasket Manhole
SD-4	040	Shallow Flat Top Manhole
SD-5	050	Flat Top Manhole
SD-6	070	Inside Drop Manhole
SD-7	080	Inside Drop for Large-Diameter Pipe
SD-8	100	Manhole Step
SD-9	110	Suburban and Standard Manhole Frame and Cover
SD-10	120	Watertight Manhole Frame and Cover
SD-11	130	Concrete Manhole Closure Collar
SD-12	140	Manhole Chimney Seal
SD-13	150	Standard Cleanout
SD-14	160	Cleanout Frame and Cover
SD-15	170	Side Service
SD-16	175	6" Public Side Service
SD-17	180	PVC Gasketed Saddle
SD-18	190	Inserta-Tee
SD-19	195	Curb Inlet Manhole (CG-48MH)
SD-20	200	Curb Inlet Manhole (Top) (CG-48MH)
SD-21	205	Curb Inlet Manhole (CG-48MH Modified)
SD-22	220	Area Drain Type II
SD-23	225	Gutter & Curb Inlet Catch Basin (CG-2)
SD-24	226	Gutter & Curb Inlet Catch Basin Reinforcement (CG-2)
SD-25	230	Curb Inlet Catch Basin (CG-30)
SD-26	240	Curb Inlet Catch Basin (CG-48)
SD-27	250	Ditch Inlet
SD-28	255	Catch Basin Frame & Grate (LG-2)
SD-29	260	Ditch Inlet Frame and Grate
SD-30	270	Creek Crossing Restoration
SD-31	280	Trench Backfill Details
SD-32	285	T-Cut Asphalt Details
SD-33	370	Bore Detail
SD-34	371	Concrete Cap
SD-35	372	Concrete Encasement/Closure Collar

**APPENDIX E
STANDARD DETAILS (cont'd)**

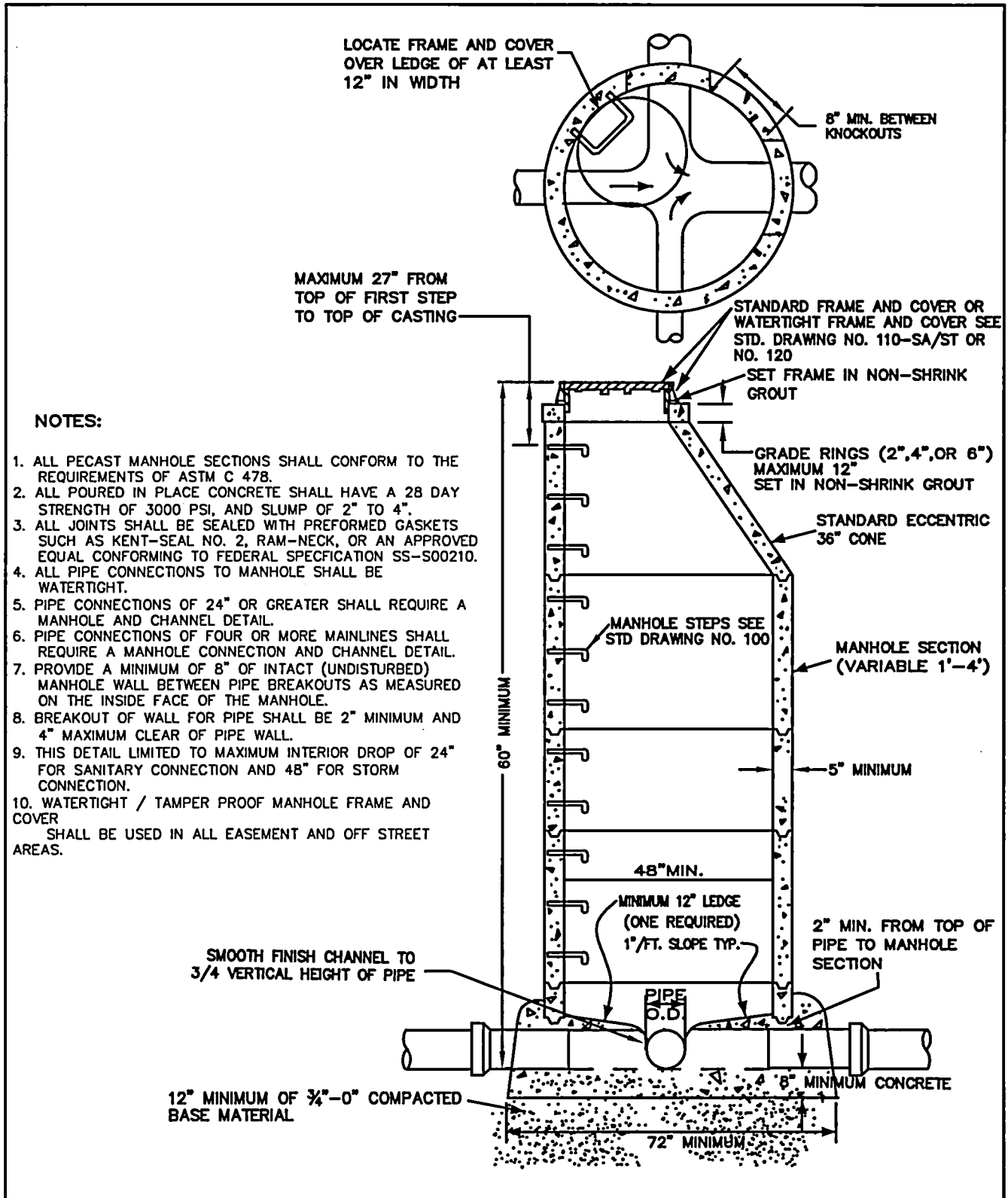
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SD-38	520	Water Quality Swale
SD-39	530	Water Quality Swale Construction & Maintenance Notes
SD-40	544	Alternative Outflow Control Structure (CG-48MH Modified)
SD-41	545	Water Quality Outflow Control Structure
SD-42	546	Orifice Plate & Guide
SD-43	600	Float Switch Plan and Detail C
SD-44	610	Float Switch Section A
SD-45	620	Float Switch Detail B
SD-46	630	Sample Design Data Table
SD-47	640	Force Main Pressure Gauge
SD-48	650	Large Precast Manhole
SD-49	655	Large Precast Manhole-Bases
SD-50	660	Large Precast Manhole- Types
SD-51	665	Large Precast Manhole Base Slabs
SD-52	670	Large Precast Manhole Base Slabs
SD-53	675	Large Precast Manhole Base Section Reinforcement
SD-54	680	Large Precast Manhole Top Slabs
SD-55	685	T-Top Manhole w 48" Riser
SD-56	695	Sanitary Permanent Flow Monitor Detail
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SD-58	700	Air Test Form
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SD-60	710	Manhole Vacuum Test
SD-61	715	Manhole Hydrostatic Test
SD-62	720	Average Velocities for Estimating Travel Time for Overland Flows
SD-63	725	Headwater Depth for Corrugated Pipe w/Inlet Control
SD-64	730	Headwater Depth for Smooth Interior Pipe Culverts with Inlet Control
SD-65	735	Head for Culverts (Pipe w/"n" \leq 0.012), Flowing Full with Outlet Control
SD-66	740	Head for Culverts (Pipe w/"n" \leq 0.024), Flowing Full with Outlet Control
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SD-68	1003	Conceptual Site Schematic
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SD-73	1072	Electrical Interior Enclosure- 01
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STANDARD DETAILS (cont'd)

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SD-79	1078	Electrical Intrinsically Safe Example Drawing
SD-80	1079	Electrical Wetwell Level Detail
SD-81	1080	Electrical Disconnect Air-Gap Junction Box Details
SD-82	1081	Electrical Light Pole Detail



NOTES:

1. ALL PECAST MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C 478.
2. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI, AND SLUMP OF 2" TO 4".
3. ALL JOINTS SHALL BE SEALED WITH PREFORMED GASKETS SUCH AS KENT-SEAL NO. 2, RAM-NECK, OR AN APPROVED EQUAL CONFORMING TO FEDERAL SPECIFICATION SS-S00210.
4. ALL PIPE CONNECTIONS TO MANHOLE SHALL BE WATERTIGHT.
5. PIPE CONNECTIONS OF 24" OR GREATER SHALL REQUIRE A MANHOLE AND CHANNEL DETAIL.
6. PIPE CONNECTIONS OF FOUR OR MORE MAINLINES SHALL REQUIRE A MANHOLE CONNECTION AND CHANNEL DETAIL.
7. PROVIDE A MINIMUM OF 8" OF INTACT (UNDISTURBED) MANHOLE WALL BETWEEN PIPE BREAKOUTS AS MEASURED ON THE INSIDE FACE OF THE MANHOLE.
8. BREAKOUT OF WALL FOR PIPE SHALL BE 2" MINIMUM AND 4" MAXIMUM CLEAR OF PIPE WALL.
9. THIS DETAIL LIMITED TO MAXIMUM INTERIOR DROP OF 24" FOR SANITARY CONNECTION AND 48" FOR STORM CONNECTION.
10. WATERTIGHT / TAMPER PROOF MANHOLE FRAME AND COVER SHALL BE USED IN ALL EASEMENT AND OFF STREET AREAS.

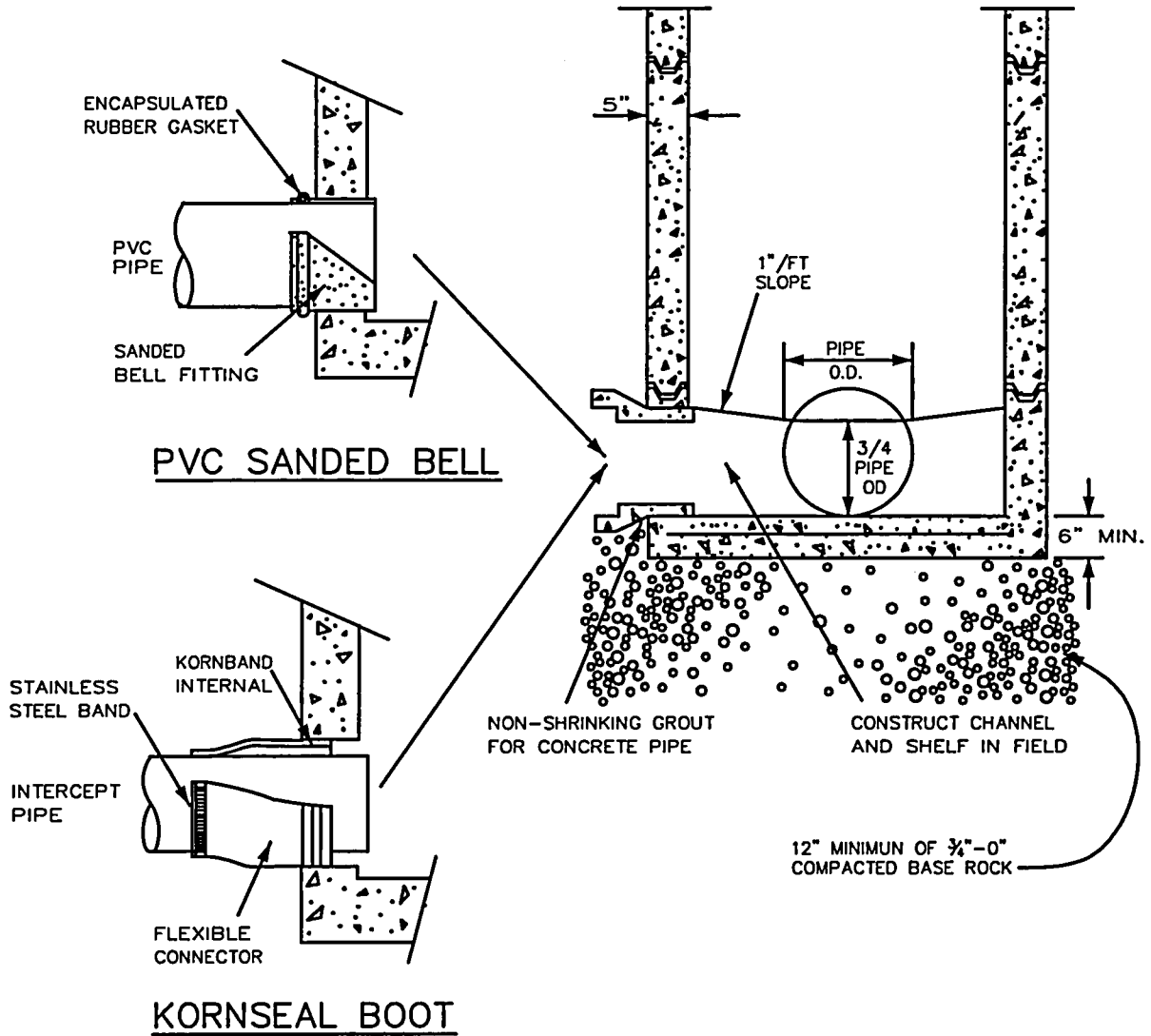
STANDARD MANHOLE

DRAWING NO. 010

REVISED 02-03



NOTES:
 ALL PRECAST MANHOLE SECTIONS SHALL
 CONFORM TO THE REQUIREMENTS OF ASTM
 C-478 AND APPLICABLE PROVISIONS OF
 STANDARD DRAWING
 NO. 010.



PRECAST CONCRETE MANHOLE BASE

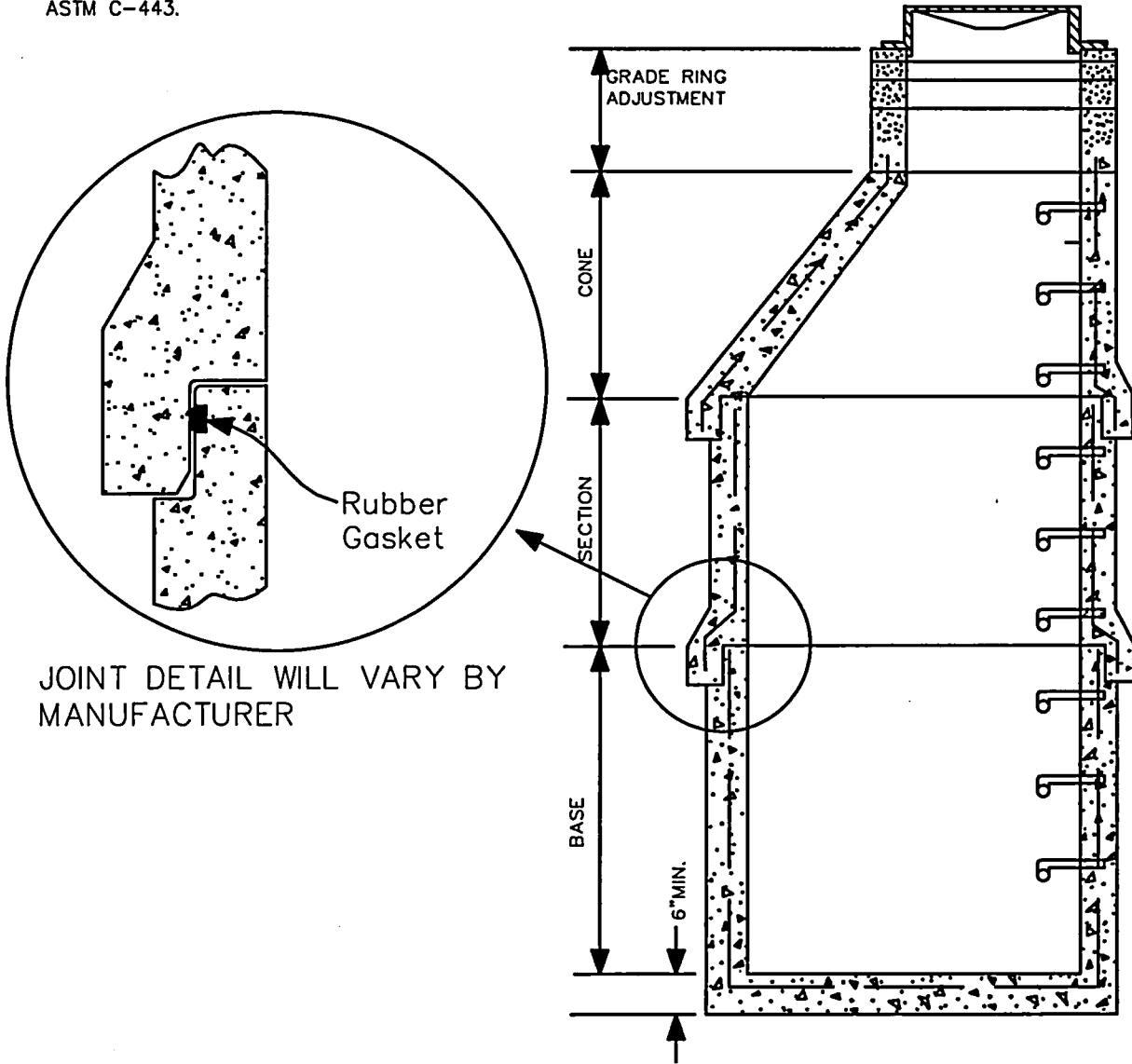
DRAWING NO. 020

REVISED 02-03



NOTES:

1. ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STANDARD MANHOLE, DRAWING NO. 010.
2. ALL JOINTS AND RUBBER GASKETS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-443.



PRECAST RUBBER GASKET MANHOLE

DRAWING NO. 030

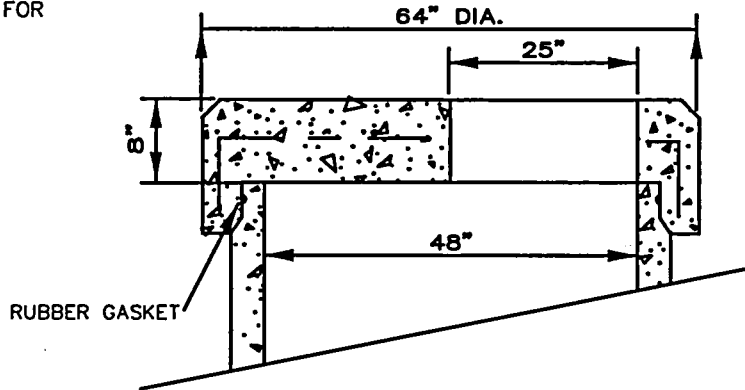
REVISED 02-03

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NOTES:

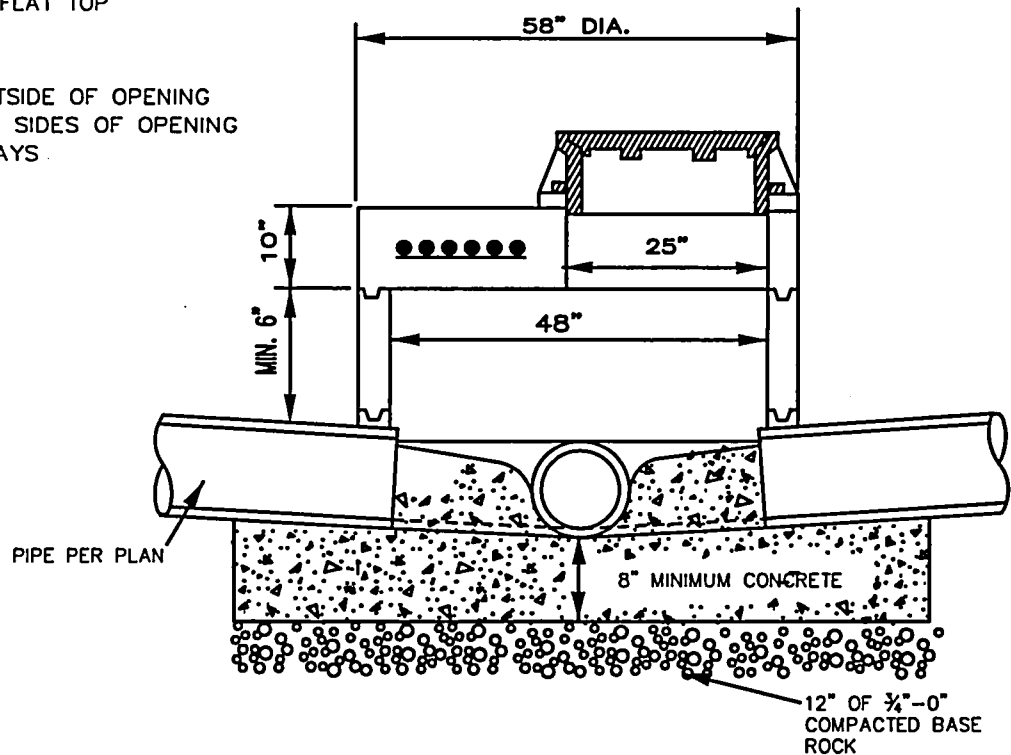
1. ALL JOINTS AND RUBBER GASKETS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-433.
2. ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STANDARD MANHOLE, DRAWING NO. 010.
3. STEPS REQUIRED ON FLAT TOP MANHOLES DEEPER THAN 48".
4. PROVIDE CENTER OPENING FLATOP FOR MANHOLE DEPTHS LESS THAN 36".

RUBBER GASKET FLAT TOP (OPTIONAL)



RUBBER GASKET FLAT TOP
REINFORCEMENT
OR
STANDARD MANHOLE FLAT TOP
REINFORCEMENT

- #6 BAR AROUND OUTSIDE OF OPENING
- #6 DIAGONALS BOTH SIDES OF OPENING
- #6 6" O.C. BOTH WAYS



SHALLOW FLAT TOP MANHOLE

DRAWING NO. 040

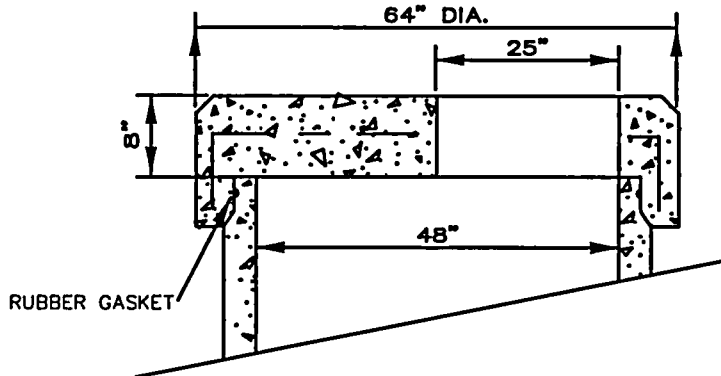
REVISED 02-03


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NOTES:

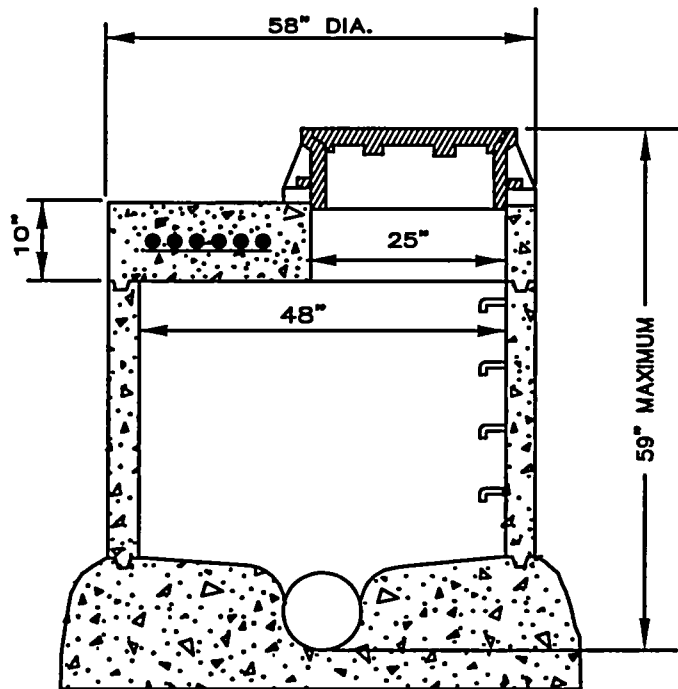
1. ALL JOINTS AND RUBBER GASKETS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-433.
2. ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STANDARD MANHOLE, DRAWING NO. 010.
3. STEPS REQUIRED ON FLAT TOP MANHOLES DEEPER THAN 48".

RUBBER GASKET FLAT TOP (OPTIONAL)



RUBBER GASKET FLAT TOP
REINFORCEMENT
OR
STANDARD MANHOLE FLAT TOP
REINFORCEMENT

- #6 BAR AROUND OUTSIDE OF OPENING
- #6 DIAGONALS BOTH SIDES OF OPENING
- #6 6" O.C. BOTH WAYS

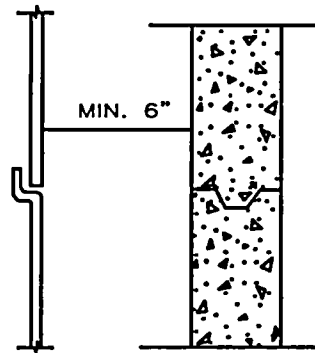
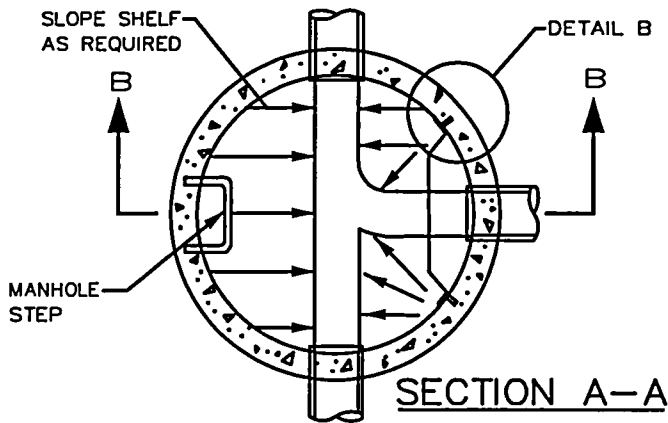


FLAT TOP MANHOLE

DRAWING NO. 050

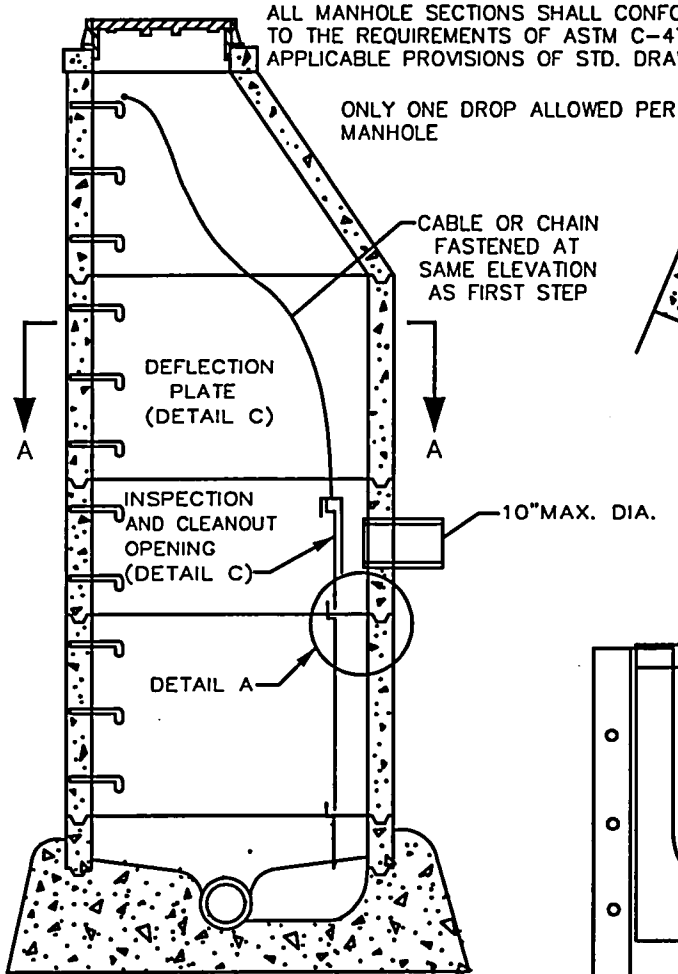
REVISED 02-03


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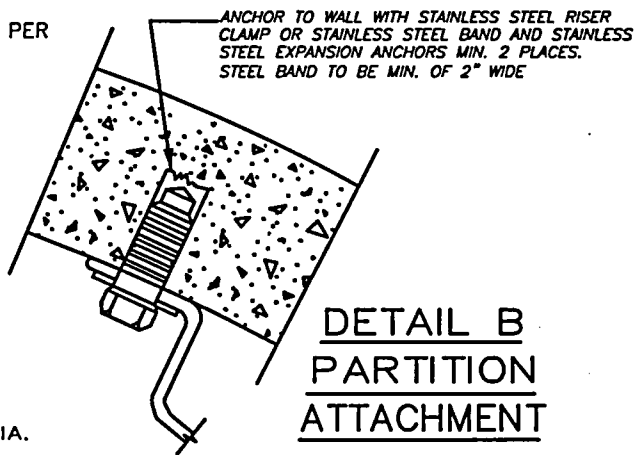


**DETAIL A
(PARTITION LOCATION)**

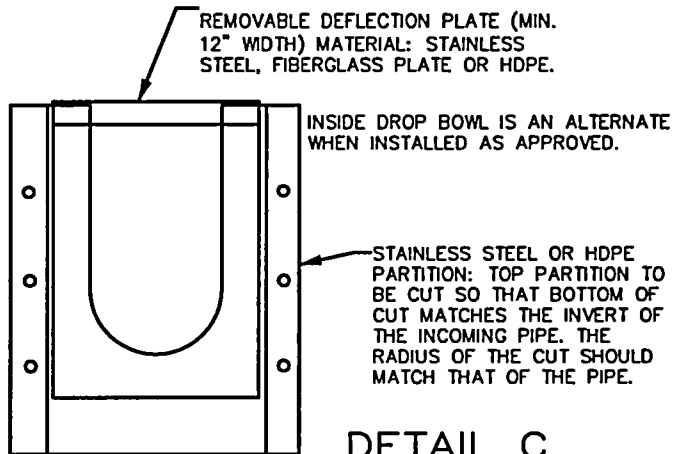
ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STD. DRAWING NO. 010



SECTION B-B



**DETAIL B
PARTITION
ATTACHMENT**



DETAIL C

INSIDE DROP MANHOLE

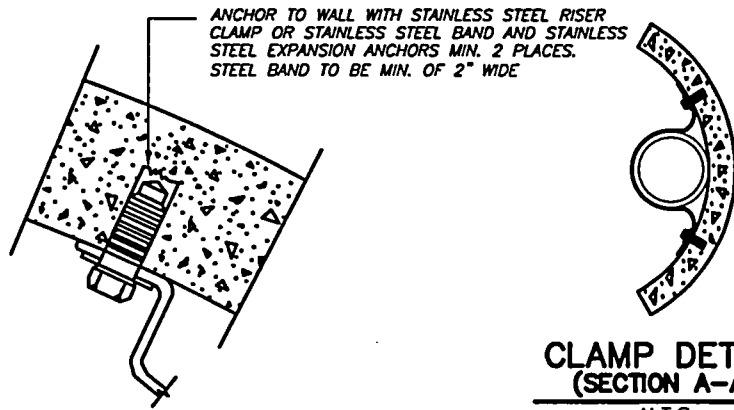
DRAWING NO. 070

REVISED 02-03



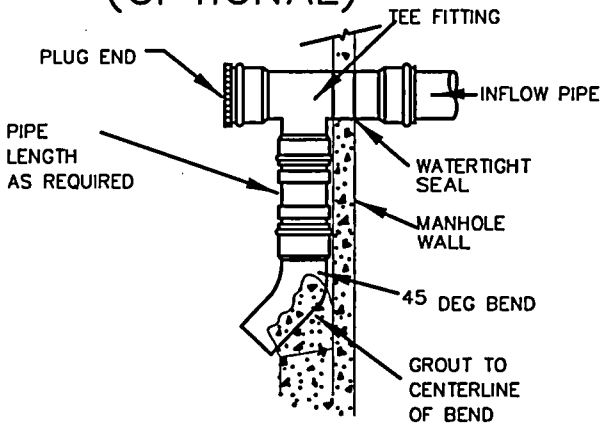
NOTES:

1. ALL MANHOLE 48" RISER SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STD. MANHOLE DRAWING NO. 010.
2. MAXIMUM FREE FALL FOR INSIDE DROP PIPE: SHALL BE 24" FOR SANITARY AND 48" FOR STORM; FROM FLOW LINE OF PIPE INVERT TO TOP OF SHELF.
3. INSIDE DROP PIPE TO EXTEND A MINIMUM OF 1" BEYOND SHELF.



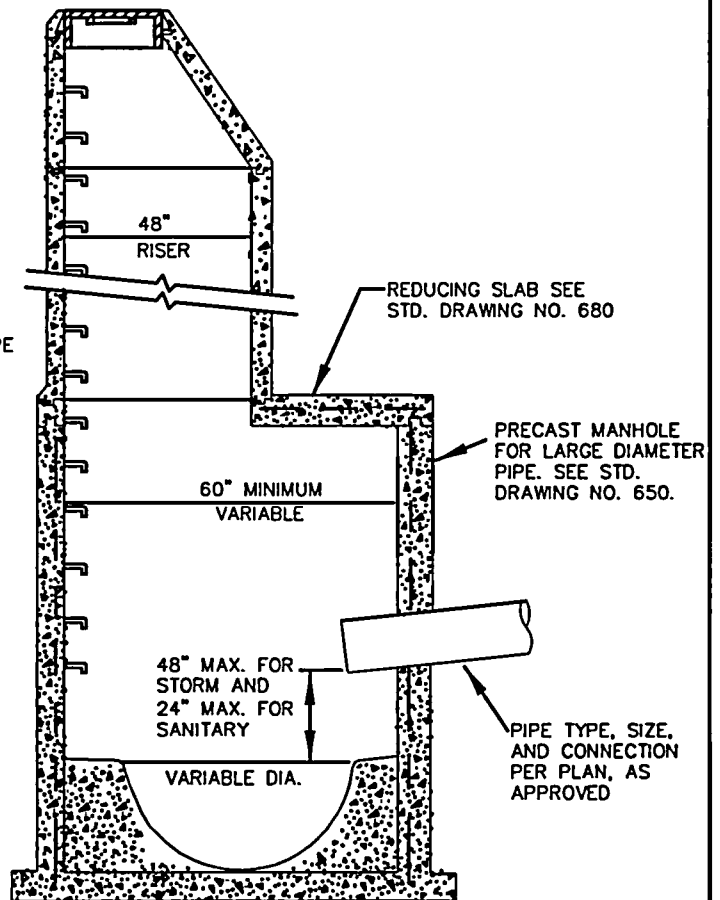
**CLAMP DETAIL
(SECTION A-A)**
N.T.S.

**MECHANICAL
INSIDE DROP
(OPTIONAL)**



NOTES:

1. PIPE AND FITTINGS SHALL BE SAME SIZE AS INFLOW PIPE TO MANHOLE.
2. PIPE AND FITTINGS FOR DROP ASSEMBLY SHALL BE:
DUCTILE IRON ANSI A21.50-1, AWWA C150-1, AWWA C-900 OR PVC ASTM 3034 SDR 35.

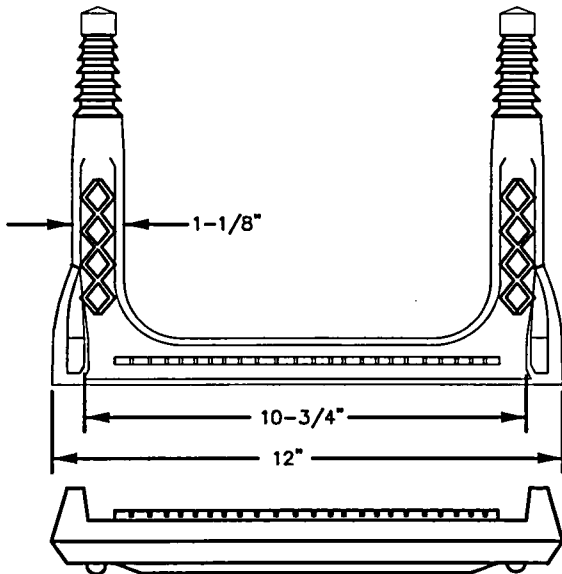


**INSIDE DROP FOR
LARGE-DIAMETER PIPE**

DRAWING NO. 080

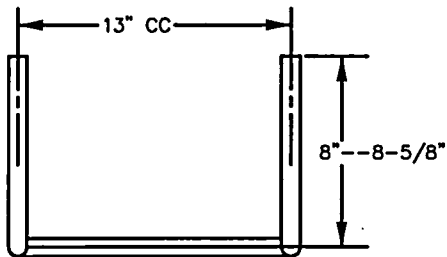
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COPOLYMER POLYPROPYLENE PLASTIC

1/2" GRADE 60 REINFORCEMENT



#6 3/4" GALVANIZED BAR

MATERIALS:

GALVANIZED:

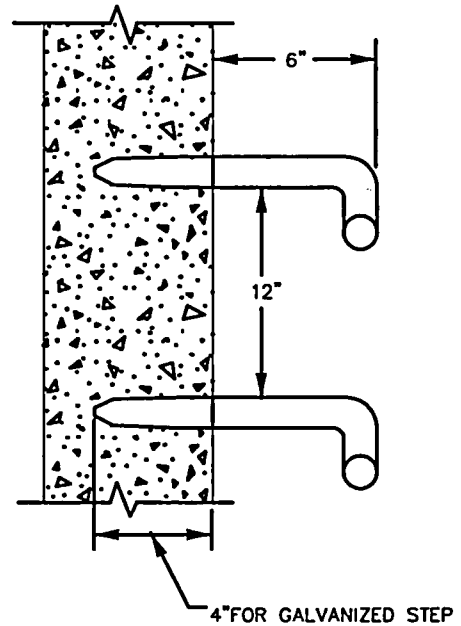
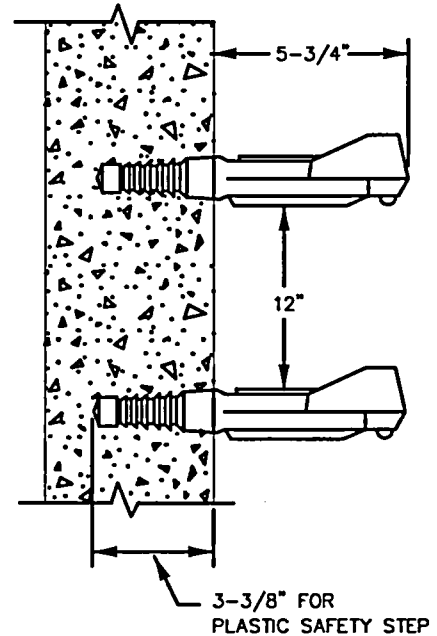
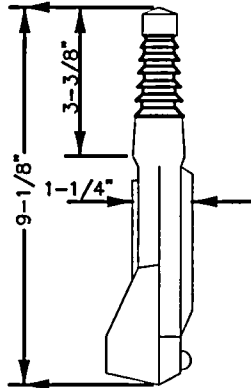
#6 (3/4" DIA.) GALVANIZED DEFORMED REINFORCING BAR.
 REINFORCING BAR CONFORMING WITH ASTM A-615 GRADE 40.
 GALVANIZED CONFORMING WITH ASTM A-123.

PLASTIC:

MUST CONFORM WITH ASTM C-478.
 STEEL REINFORCING BAR MINIMUM 1/2" GRADE 60.
 MEETING REQUIREMENTS OF ASTM A615 ENCAPSULATED
 WITH INJECTION MOLDED COPOLYMER POLYPROPYLENE
 WITH SERRATED SURFACES.

NOTES:

1. ALL STEPS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478.
2. MANHOLE STEPS MUST BE TIGHT AND FIRMLY EMBEDDED.
3. ALL STEPS WITHIN A MANHOLE SHALL BE OF THE SAME DESIGN, TYPE, AND SIZE. (MIXING OF UNMATCHED STEPS IS NOT PERMITTED).



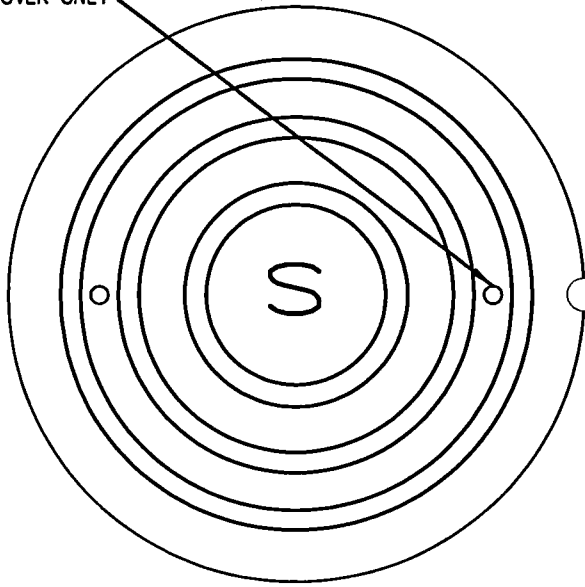
MANHOLE STEP

DRAWING NO. 100

REVISED 02-03

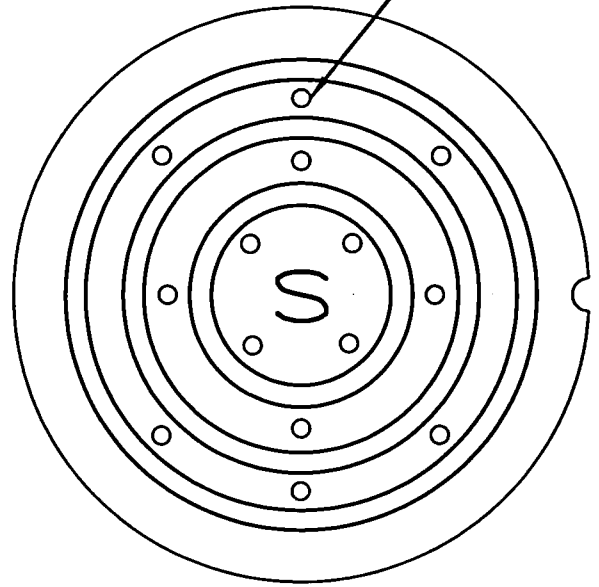


PRE-CAST 3/8" CONICAL HOLES (2) SANITARY COVER ONLY

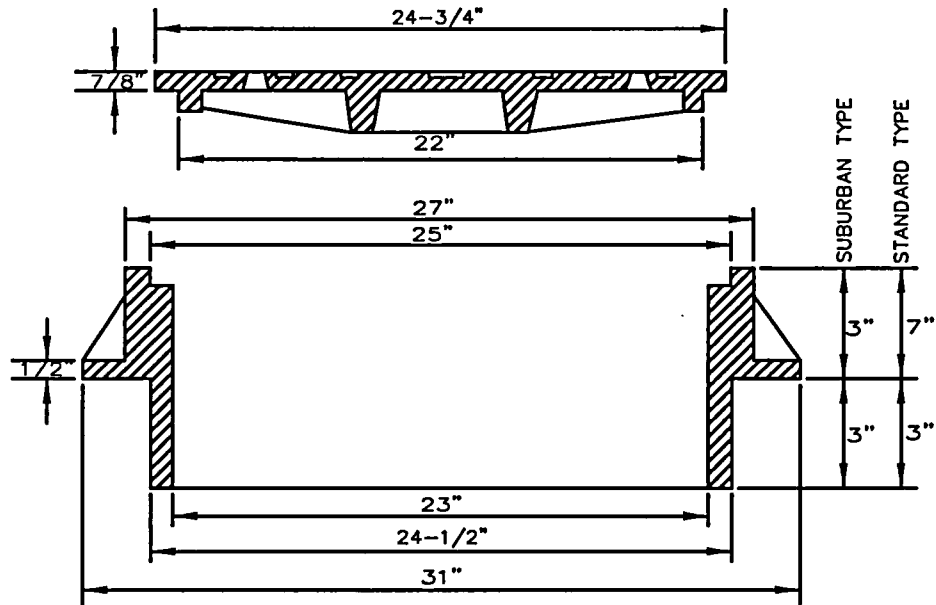


SANITARY

PRE-CAST 3/8" CONICAL HOLES (16) STORM COVER ONLY



STORM



NOTES:

1. SUBURBAN TYPE NOT FOR USE IN TRAFFIC AREAS OF COLLECTOR AND ARTERIAL STREETS
2. COVER AND FRAME SHALL BE GRAY CAST IRON ASTM A-48 CLASS 30.
3. COVER AND FRAME TO BE MACHINED TO A TRUE BEARING ALL AROUND.
4. NOTCH LID FOR LIFTING HOOK.

SUBURBAN AND STANDARD MANHOLE FRAME AND COVER

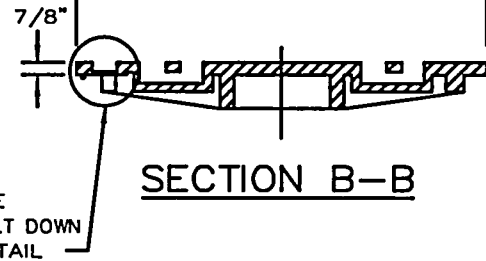
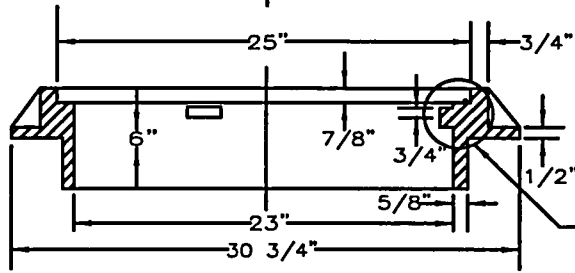
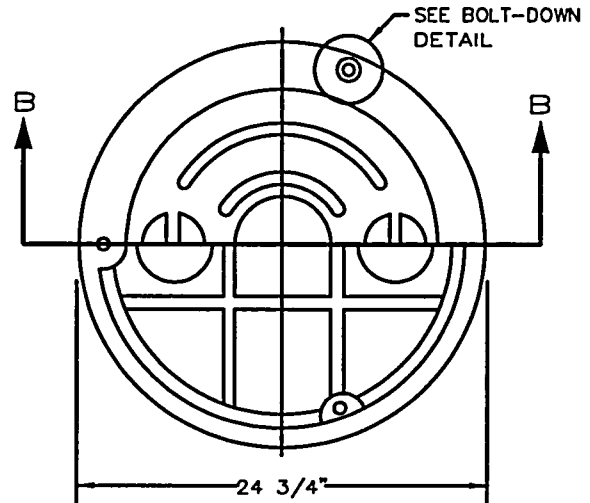
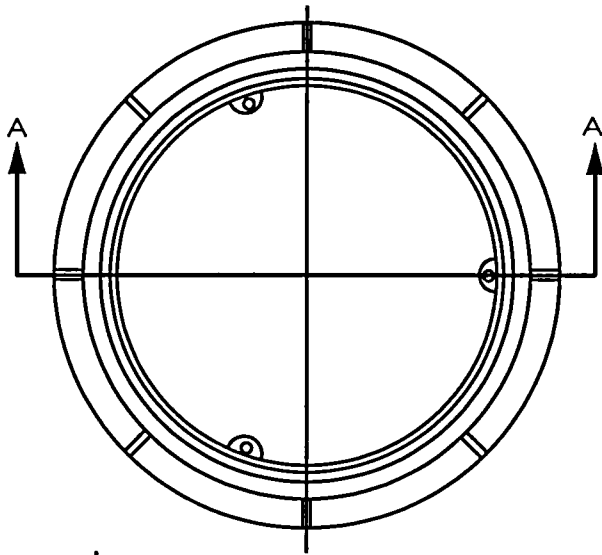
DRAWING NO. 110-SA/ST

REVISED 02-03

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WATERTIGHT MANHOLE RING

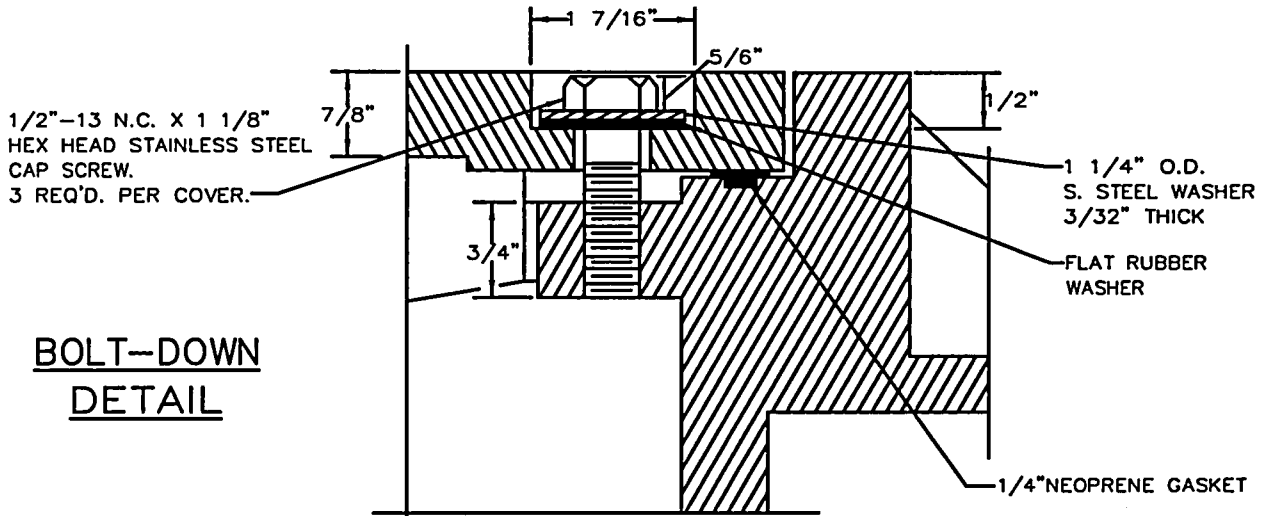
3-BOLT DOWN COVER



SECTION A-A

SECTION B-B

NOTE: WATERTIGHT/TAMPER PROOF MANHOLE FRAME AND COVER SHALL BE USED IN ALL EASEMENT AND OFF STREET AREAS.



**BOLT-DOWN
DETAIL**

NOTE: COVER AND FRAME SHALL BE OF GRAY CAST IRON A.S.T.M. A-48 CLASS 30. TAMPER PROOF (REMOVE GASKETS)

WATERTIGHT MANHOLE FRAME AND COVER

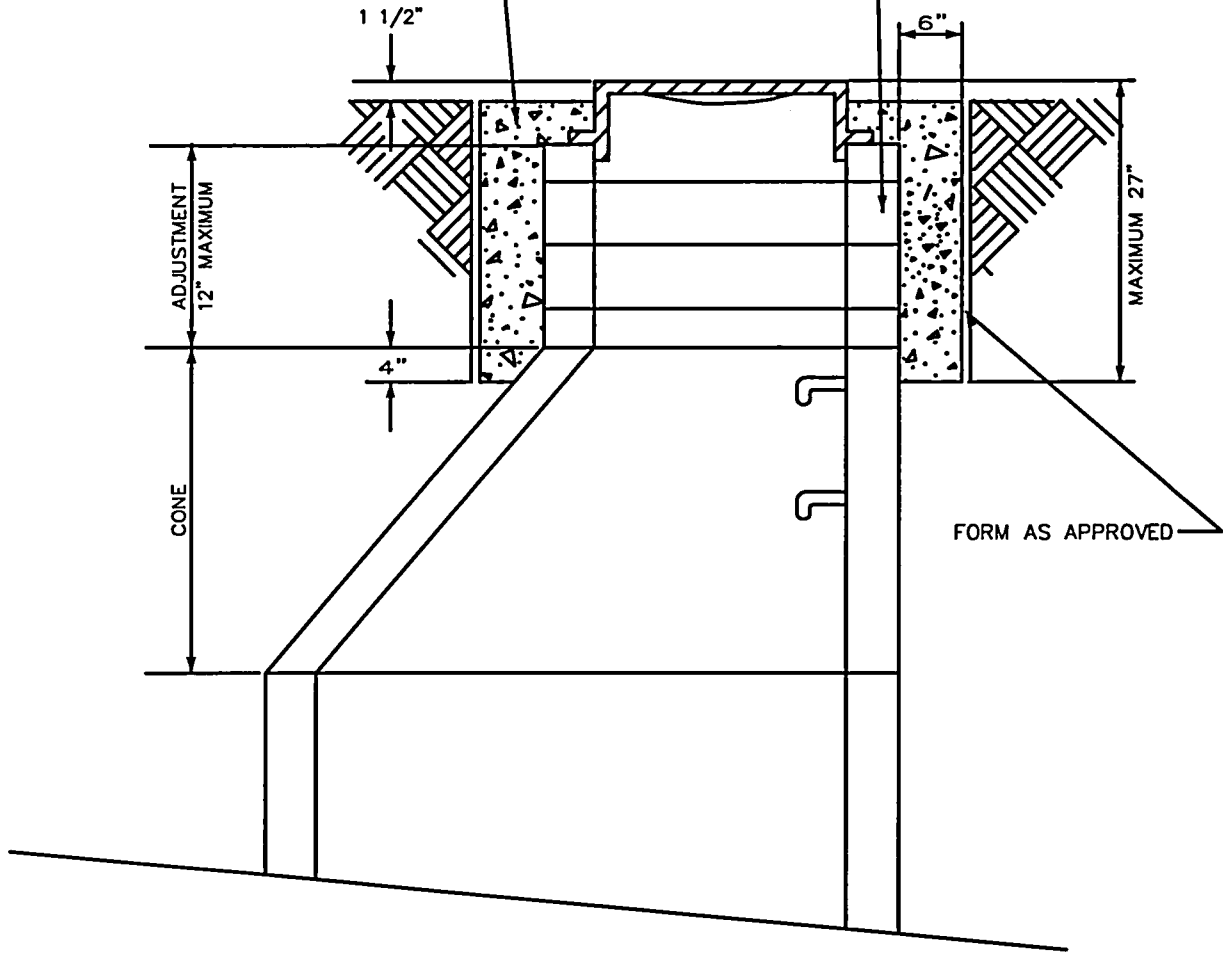
DRAWING NO. 120

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CONCRETE FOR CLOSURE COLLAR SHALL BE READY-MIXED CONFORMING WITH ASTM C94, ALTERNATE 2 AND SHALL HAVE A COMPRESSIVE STRENGTH OF 3000 PSI @28 DAYS.

ADJUSTMENT GRADE RINGS AND CASTING FRAME SET IN 1" OF NON-SHRINKING GROUT

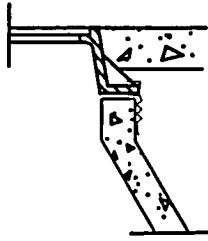


CONCRETE MANHOLE CLOSURE COLLAR

DRAWING NO. 130

REVISED 02-03

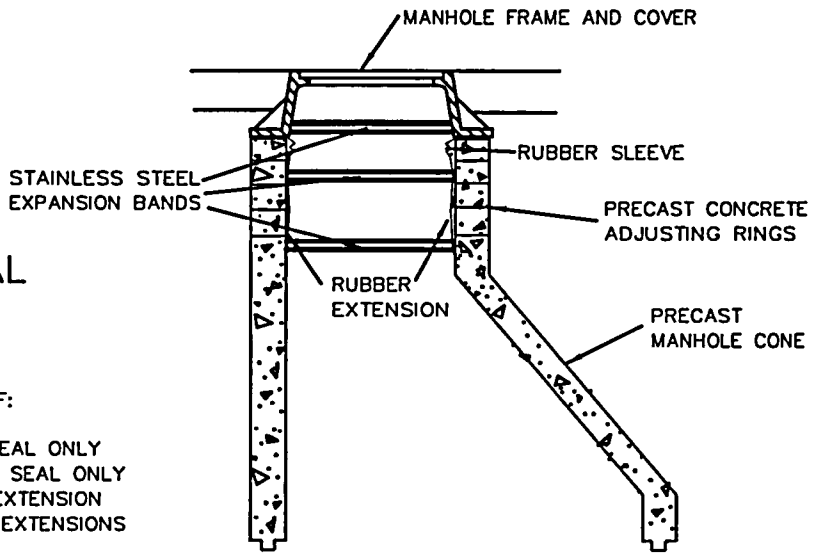
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NARROW EXTERNAL RUBBER SEAL

TO SPAN CHIMNEY HEIGHTS OF:

- 0-3" - NARROW (6") SEAL ONLY
- OVER 3" - 6 1/2" - STANDARD (9") SEAL ONLY
- OVER 6 1/2" - 12" - STD. SEAL + EXTENSION
- OVER 12" - SEAL + MULT. EXTENSIONS



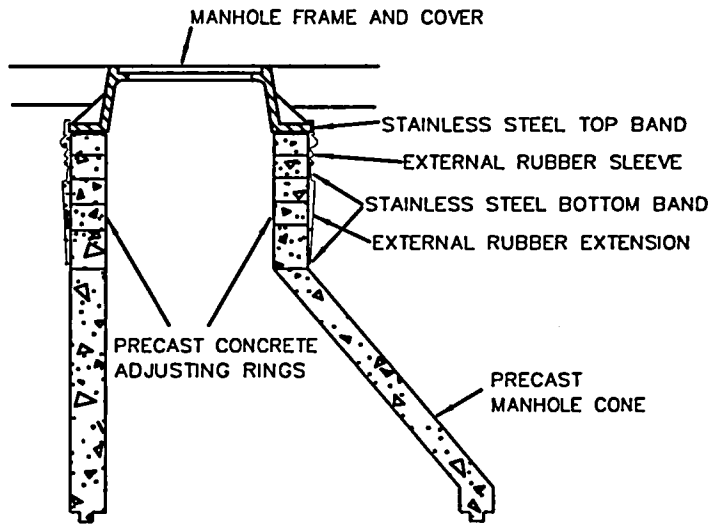
INTERNAL MANHOLE CHIMNEY SEAL

NOTES:

1. SLEEVES AND EXTENSIONS SHALL HAVE A MINIMUM OF 3/16" THICKNESS.
2. RUBBER SHALL BE EXTRUDED HIGH GRADE COMPOUND CONFORMING TO ASTM C-923.
3. BANDS SHALL BE FABRICATED FROM 16 GAUGE STAINLESS STEEL CONFORMING TO ASTM A-240, TYPE 304.
4. NUTS AND BOLTS SHALL BE STAINLESS STEEL CONFORMING TO ASTM F-593 AND 594, TYPE 304.
5. ALL GRADE RING AND CASTING FRAME SHALL BE SET IN NON-SHRINKING GROUT.
6. PRECAST MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478, AND APPLICABLE PROVISIONS OF STANDARD MANHOLE DRAWING NO. 010.

TO SPAN CHIMNEY HEIGHTS OF:

- 0-4 1/2" - CHIMNEY SEAL ONLY
- OVER 4 1/2" - 9" - SEAL + 7" EXTENSION
- OVER 9" - 12" - SEAL + 10" EXTENSION
- OVER 12" - SEAL + MULT. EXTENSIONS



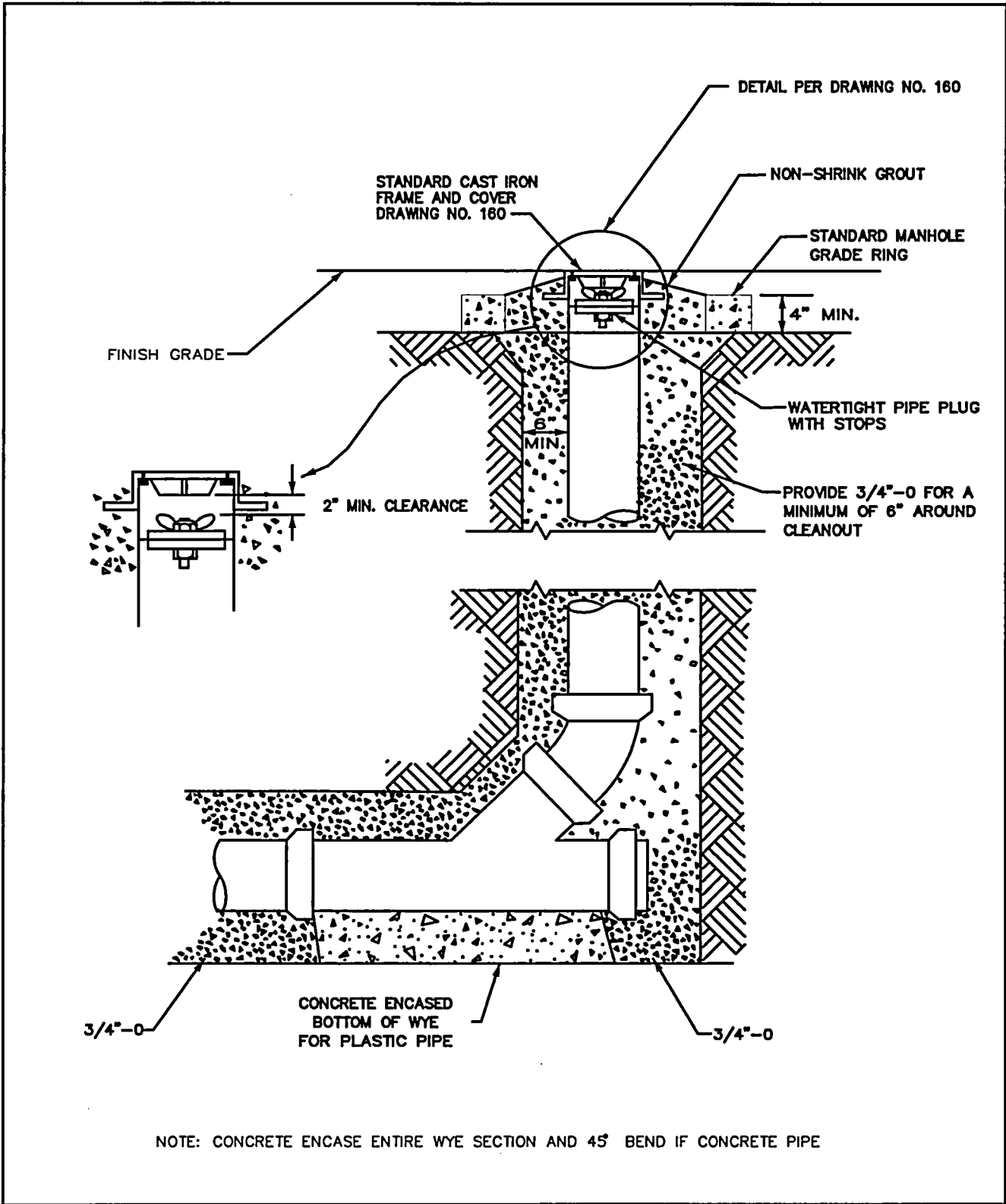
EXTERNAL MANHOLE CHIMNEY SEAL

MANHOLE CHIMNEY SEAL

DRAWING NO. 140

REVISED 02-03

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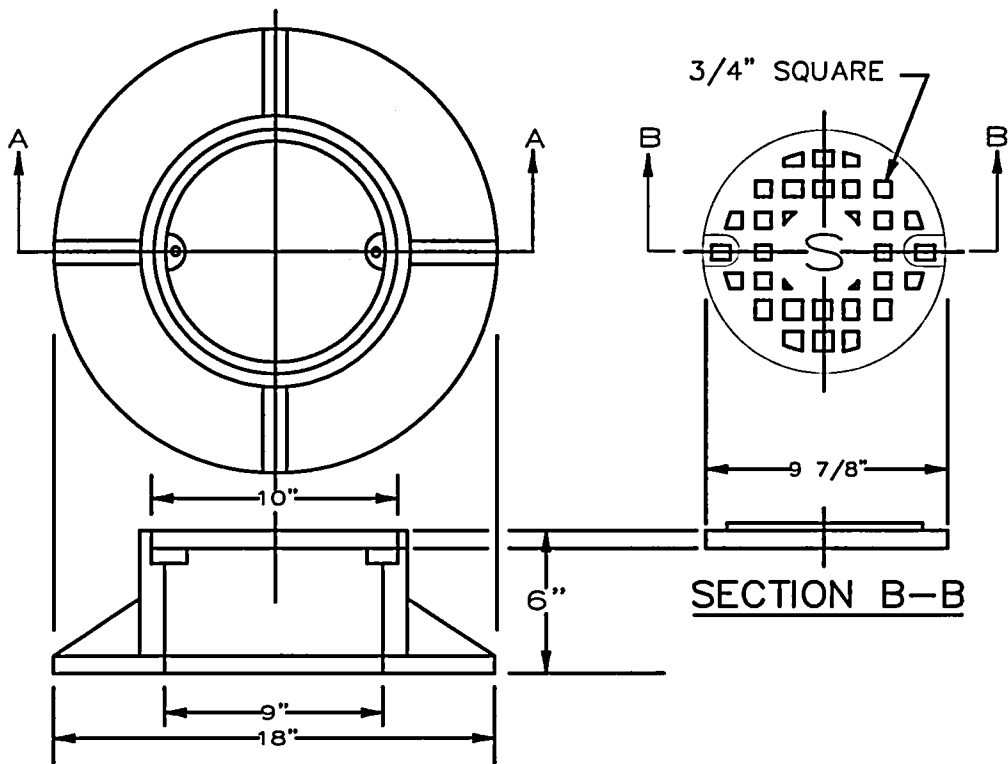


STANDARD CLEANOUT

DRAWING NO. 150

REVISED 02-03

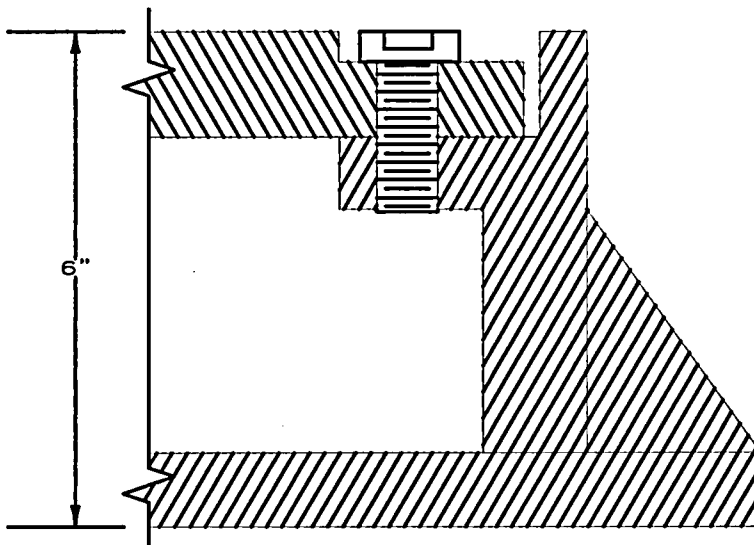
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SECTION A-A

SECTION B-B

- NOTES:
1. 1/4" ALLEN HEAD BOLTS
1" LONG RECESSED.
 2. ALL PERMANANT CLEANOUTS
TO HAVE BOLT DOWN COVERS.
 3. MATERIAL SHALL BE GRAY
CASTIRON, ASTM A-48,
CLASS 30.



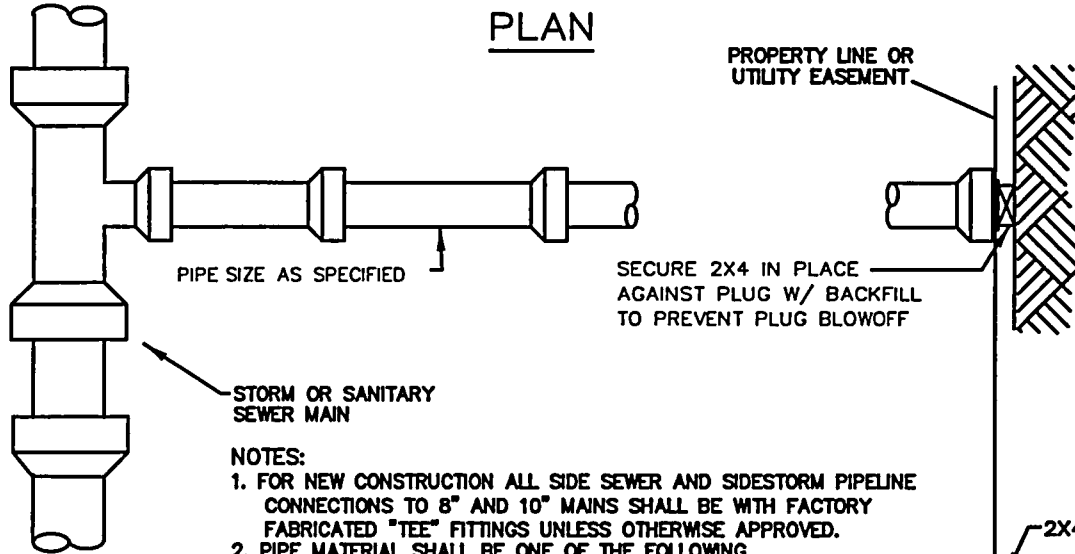
DETAIL

CLEANOUT FRAME AND COVER

DRAWING NO. 160

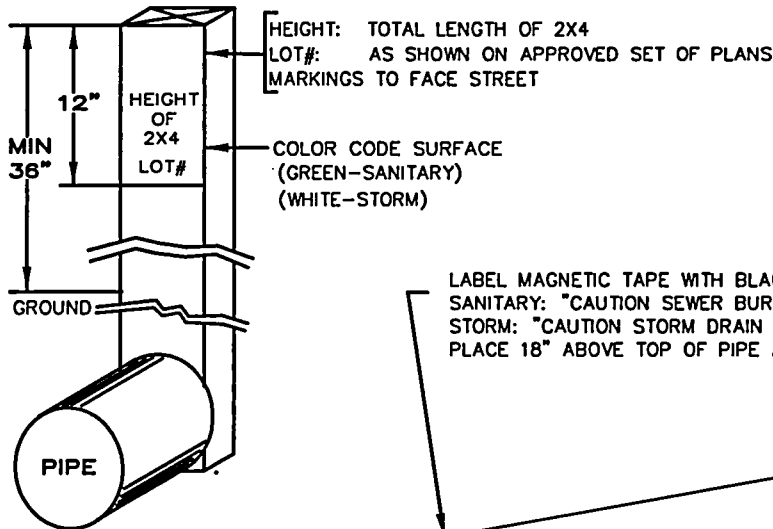
REVISED 02-03

PLAN



NOTES:

1. FOR NEW CONSTRUCTION ALL SIDE SEWER AND SIDESTORM PIPELINE CONNECTIONS TO 8" AND 10" MAINS SHALL BE WITH FACTORY FABRICATED "TEE" FITTINGS UNLESS OTHERWISE APPROVED.
2. PIPE MATERIAL SHALL BE ONE OF THE FOLLOWING
 - A. PVC ASTM-3034
ALL PIPE SHALL BE COLOR CODED:
GREEN FOR SANITARY SIDE SEWERS
WHITE FOR STORM SIDE PIPELINES
 - B. CONCRETE ASTM C-14, CL-2
 - C. DUCTILE IRON CLASS-50



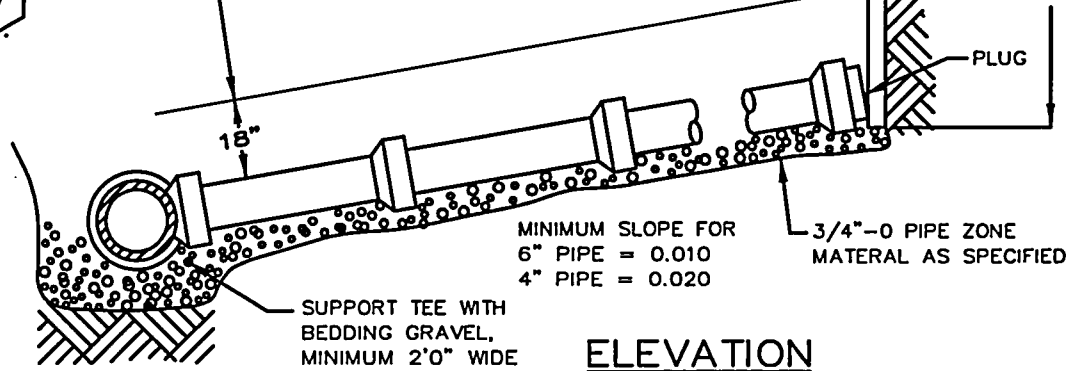
HEIGHT: TOTAL LENGTH OF 2X4
 LOT#: AS SHOWN ON APPROVED SET OF PLANS
 MARKINGS TO FACE STREET

COLOR CODE SURFACE
 (GREEN-SANITARY)
 (WHITE-STORM)

GROUND SURFACE
 MAGNETIC TAPE

LABEL MAGNETIC TAPE WITH BLACK LETTERING
 SANITARY: "CAUTION SEWER BURIED BELOW."
 STORM: "CAUTION STORM DRAIN BURIED BELOW."
 PLACE 18" ABOVE TOP OF PIPE AND AGAINST 2X4.

TOTAL LENGTH OF 2X4 IS VARIABLE



MINIMUM SLOPE FOR
 6" PIPE = 0.010
 4" PIPE = 0.020

3/4"-0 PIPE ZONE
 MATERIAL AS SPECIFIED

SUPPORT TEE WITH
 BEDDING GRAVEL,
 MINIMUM 2'0" WIDE

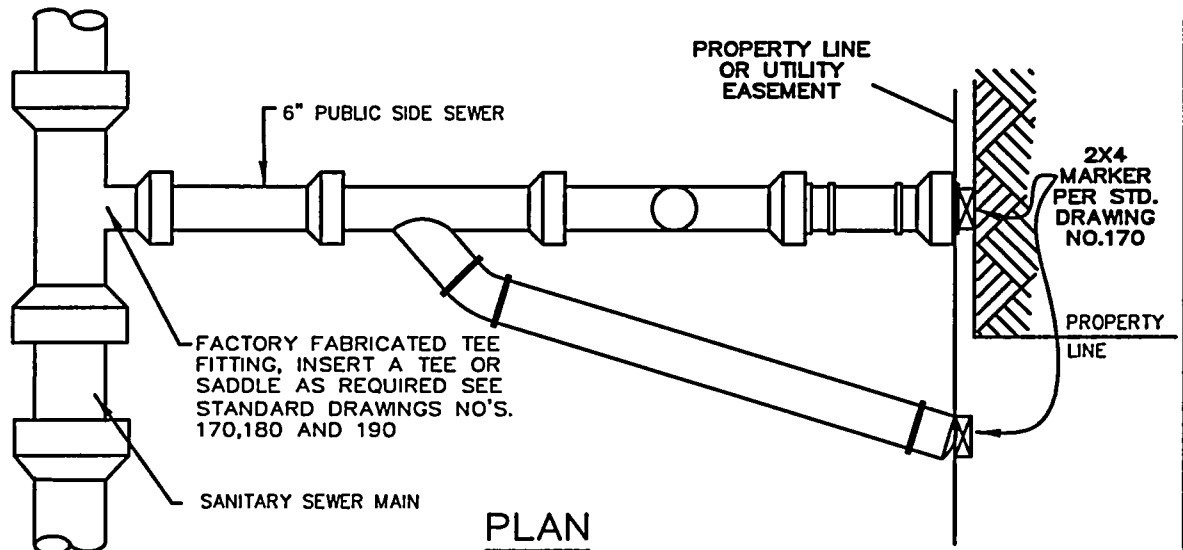
ELEVATION

**SIDE SEWER / SIDE STORM
 PIPELINE**

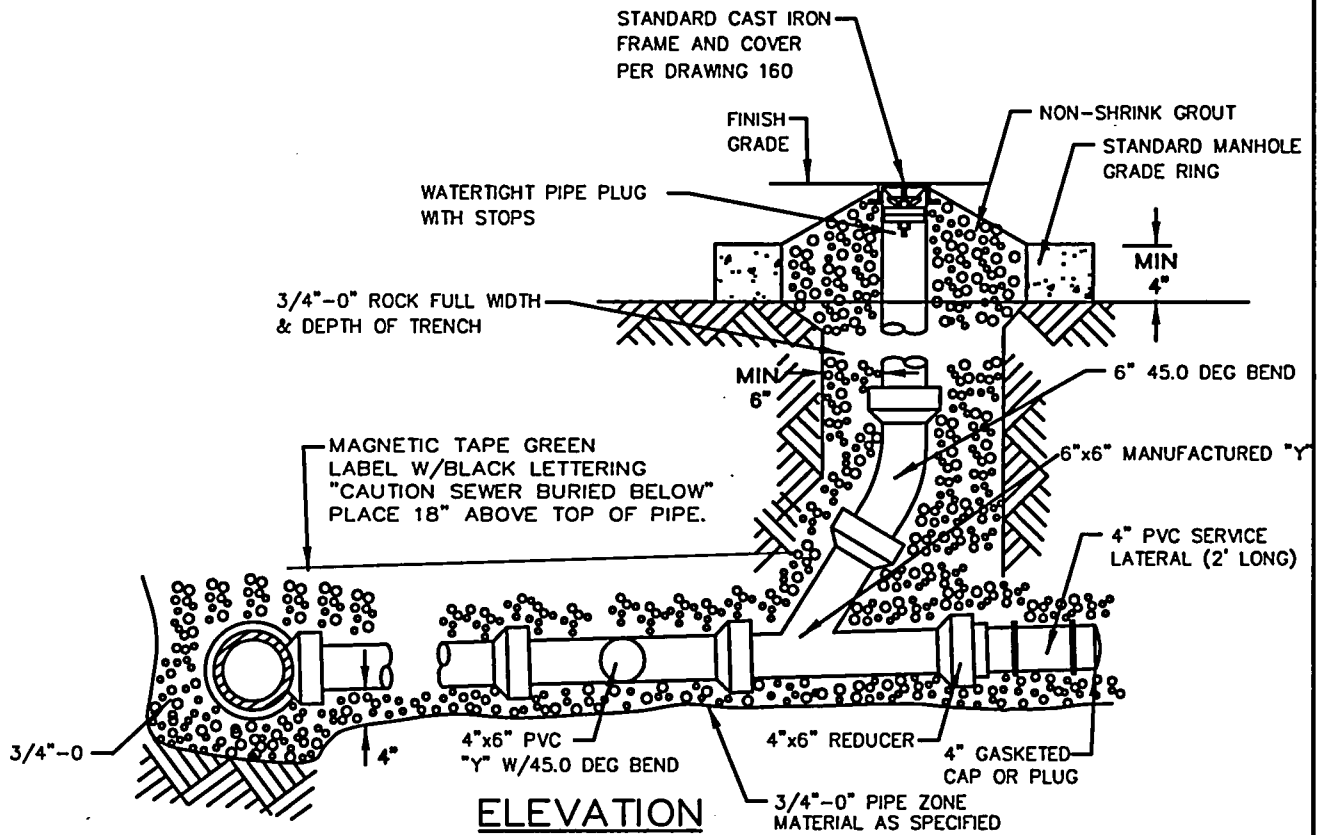
DRAWING NO. 170

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PLAN



ELEVATION

NOTES:

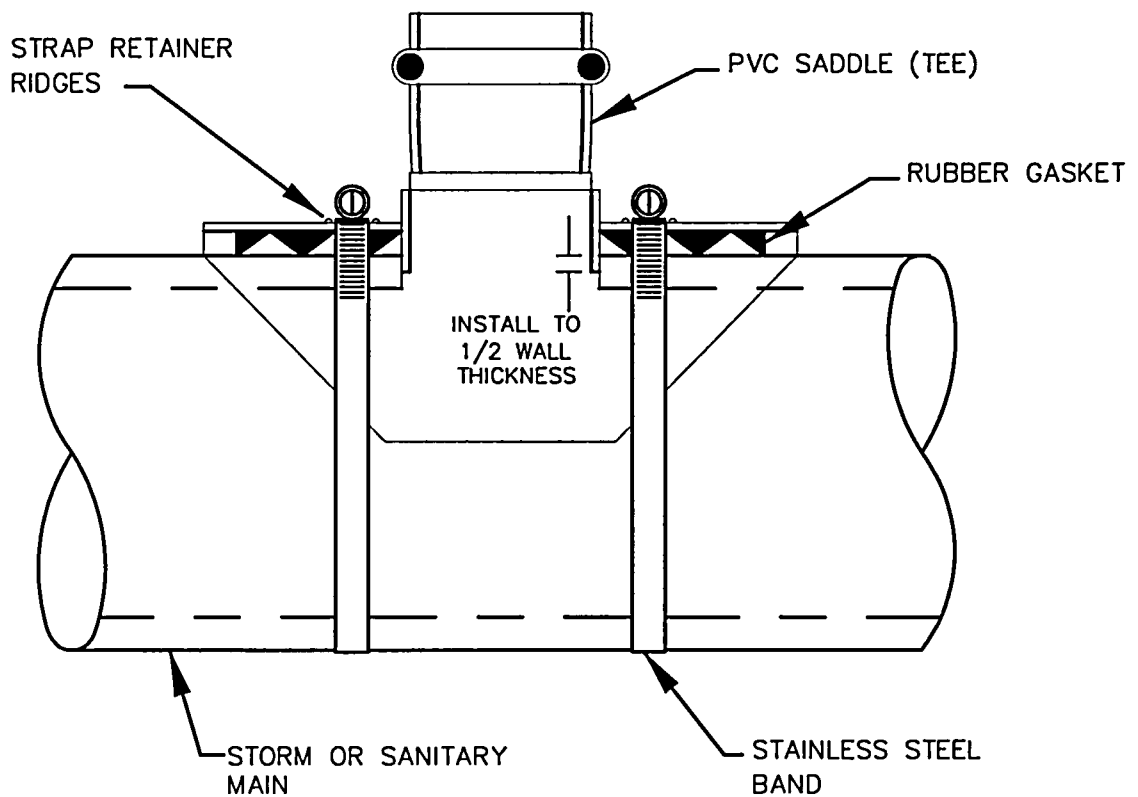
1. 2x4 SHALL BE INSTALLED AT THE END OF BOTH 4" SIDE SEWERS AND EXTENDED 3' ABOVE FINISH GRADE PER STD. DRAWING NO 170.
2. 6" PUBLIC SIDE SEWER SHALL BE LAID AT A MIN OF 0.60 PER 100 FEET.
3. DO NOT PLACE CLEANOUT IN PAVED STREET OR SIDEWALK AREA.
4. PIPE MATERIAL AND COLOR CODE PER STD. DRAWING NO. 170.

6" PUBLIC SIDE SEWER

DRAWING NO. 175

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NOTES:

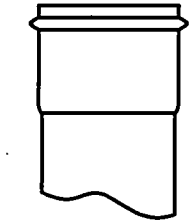
1. INDEXED PVC GASKETED SADDLE SHALL CONFORM TO ASTM 3034 SDR35.
2. PVC COMPOUNDS SHALL CONFORM TO ASTM D1784 WITH CELL CLASS OF 12454-B/C OR 12364-C.
3. ALL ELASTOMERIC SEALS (RUBBER GASKETS) SHALL CONFORM TO ASTM F477.
4. INDEXED PVC GASKETED SADDLE SHALL BE INSTALLED WITH RUBBER GASKETS APPROVED FOR THE SEWER MAIN WALL CONFIGURATION (PROFILE OR SMOOTH WALL).
5. STAINLESS STEEL BANDS SHALL BE 300 SERIES, $\frac{9}{16}$ " BAND WIDTH, CADMIUM PLATED, CARBON STEEL, AND ATTACHED WITH HEX HEAD, SLOTTED SCREWS.
6. INSERTION HOLE SHALL BE CORE DRILLED.

INDEXED PVC GASKETED SADDLE

DRAWING NO. 180

REVISED 02-03

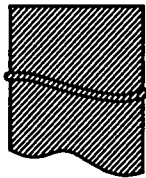
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1. PVC HUB SHALL CONFORM TO ASTM 3034, SDR 35 DRIVE INTO CENTER OF RUBBER SLEEVE AFTER SLEEVE IS PLACED IN HOLE.



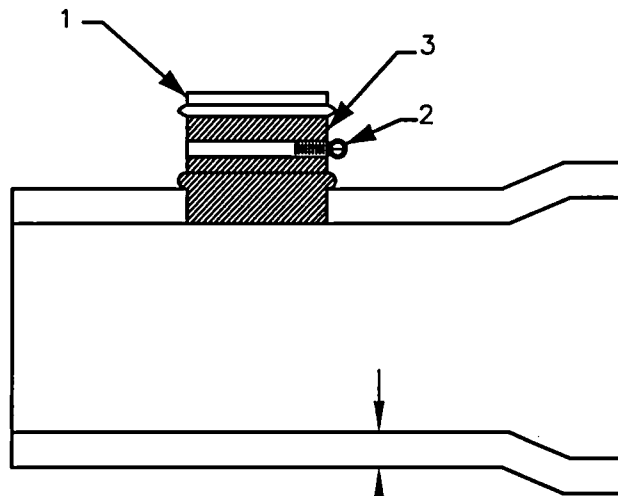
2. STAINLESS STEEL BAND SECURES UPPER HALF OF RUBBER SLEEVE TO THE PVC HUB. STAINLESS STEEL BAND SHALL BE 300 SERIES, $\frac{9}{16}$ " BAND WIDTH, CADMIUM PLATED CARBON STEEL, AND ATTACHED WITH HEX HEAD SLOTTED SCREW.



3. COMPLETE RUBBER SLEEVE INCLUDES A MOLDED SEGMENT THAT HOLDS IT IN PLACE.

4. INSERTA TEE SHALL BE USED ONLY IN SEWER MAINS 10" AND LARGER INSIDE DIAMETER (I.D.)

5. SEWER MAIN SHALL BE TWO SIZES (NOMINAL I.D.) LARGER THAN THE INSERTA TEE.



.35 MINIMUM WALL THICKNESS

NOTE:

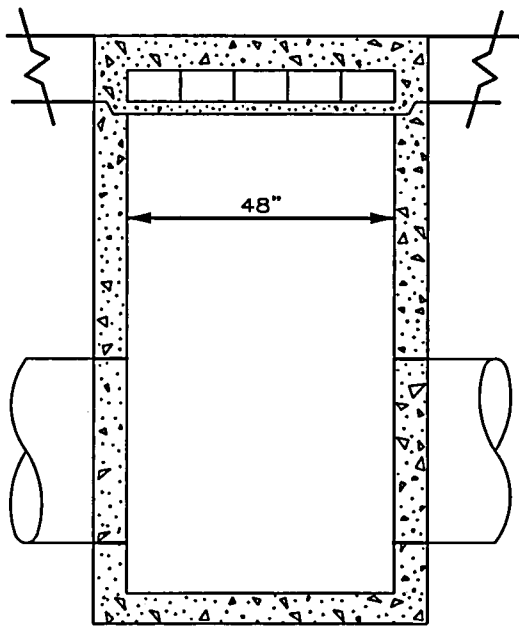
ALL INSERTA-TEE HOLES SHALL BE MACHINE DRILLED AND CORED.

INSERTA-TEE

DRAWING NO. 190

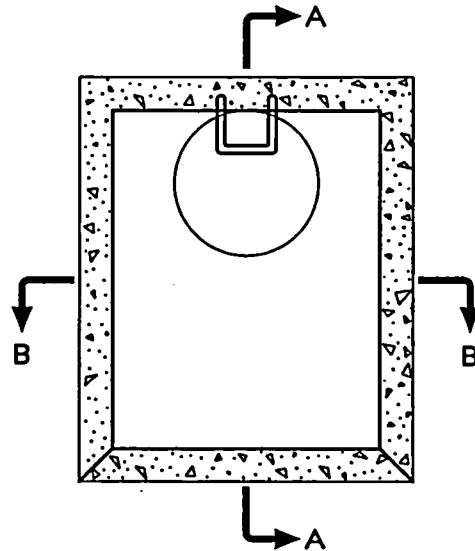
REVISED 02-03


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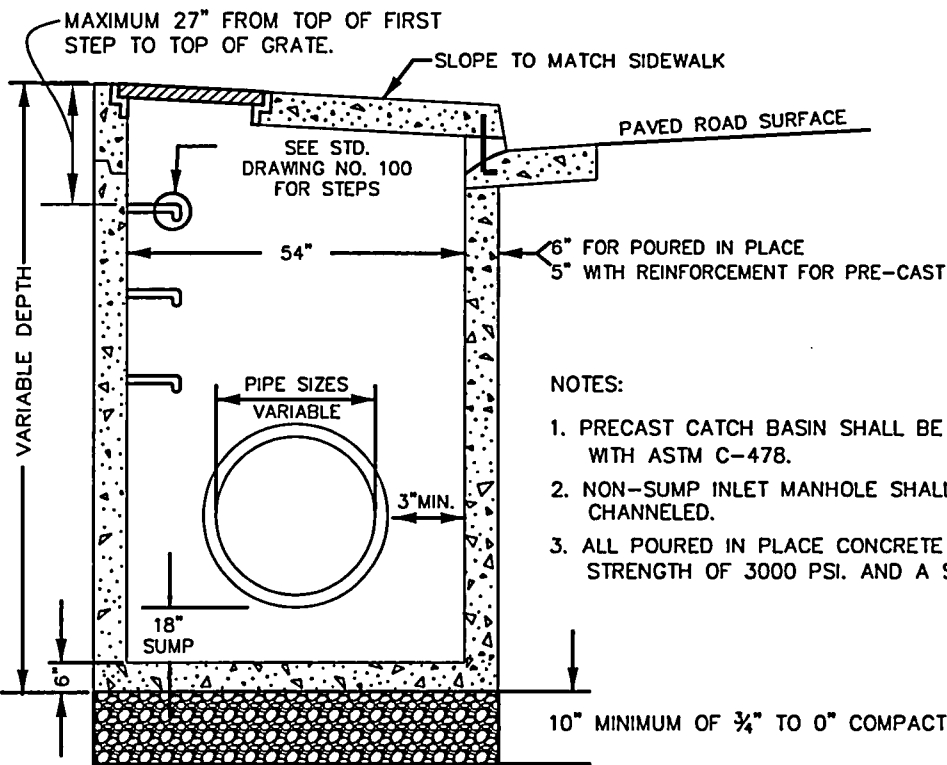


SECTION B-B

SEE STD. DRAWING NO. 200
FOR TOP SECTION DETAILS



PLAN VIEW



SECTION A-A

NOTES:

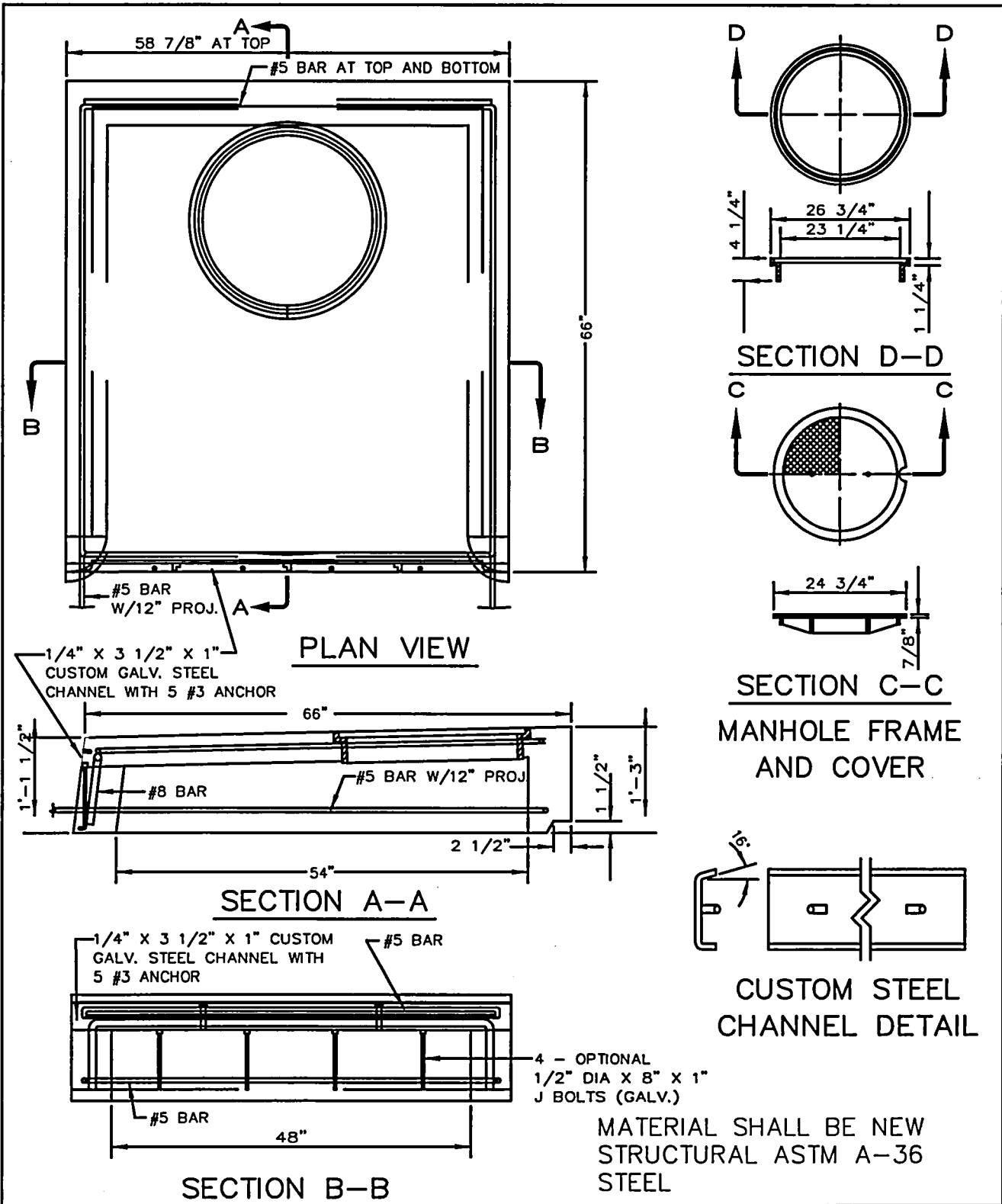
1. PRECAST CATCH BASIN SHALL BE CONSTRUCTED IN ACCORDANCE WITH ASTM C-478.
2. NON-SUMP INLET MANHOLE SHALL BE CHANNLED.
3. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI. AND A SUMP OF 2" TO 4"

CURB INLET MANHOLE
(CG-48 M.H.)

DRAWING NO. 195

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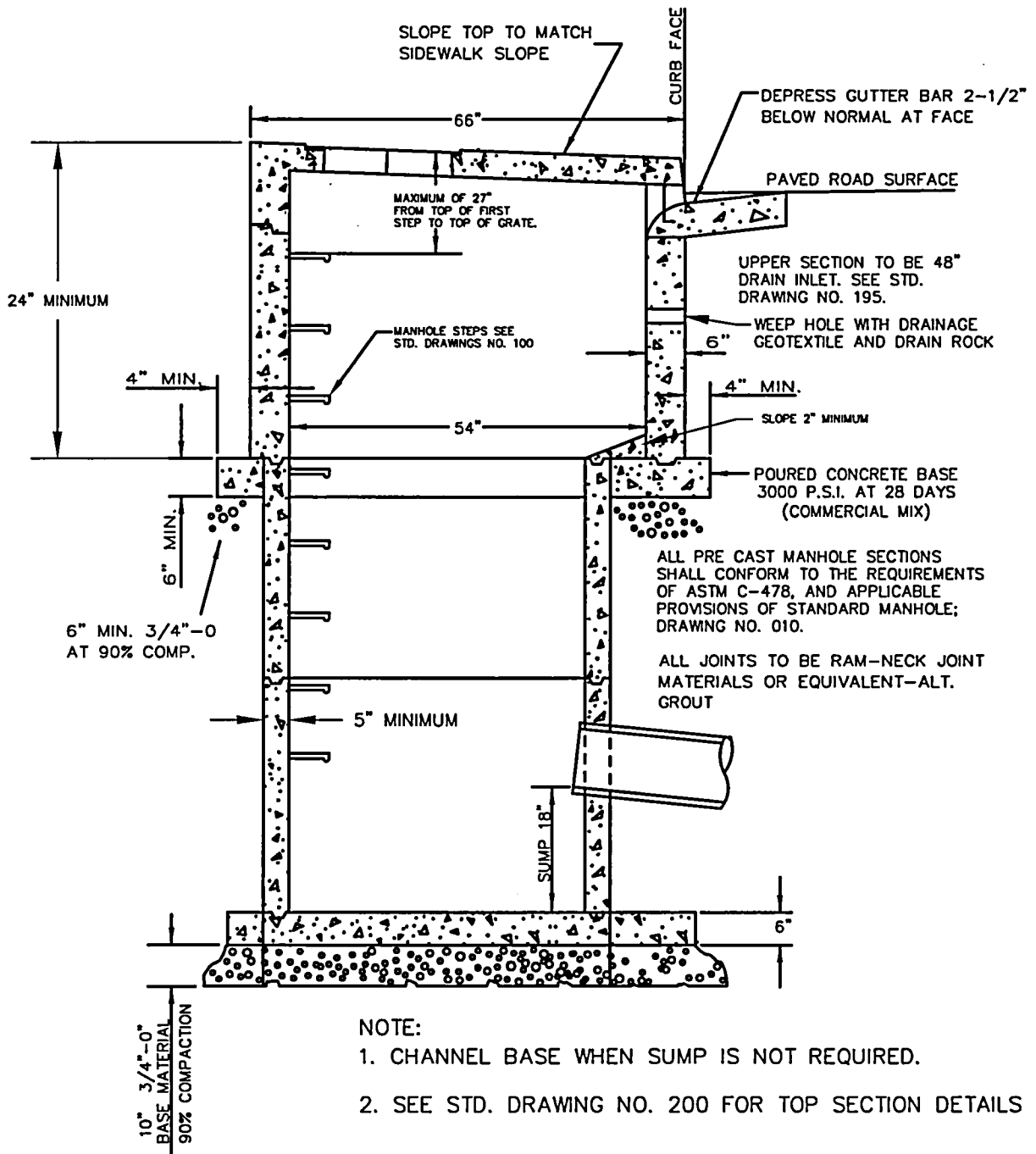


**TOP-CURB INLET MANHOLE AND
MODIFIED CURB INLET MANHOLE
(CG-48 M.H. AND MOD. CG-48 M.H.)**

DRAWING NO. 200

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STANDARD M.H. RUNGS REQUIRED 12" O.C. OR ALT. OSHA APPROVED STEPS OR LADDER. SEE STD. DRAWING NO. 100.



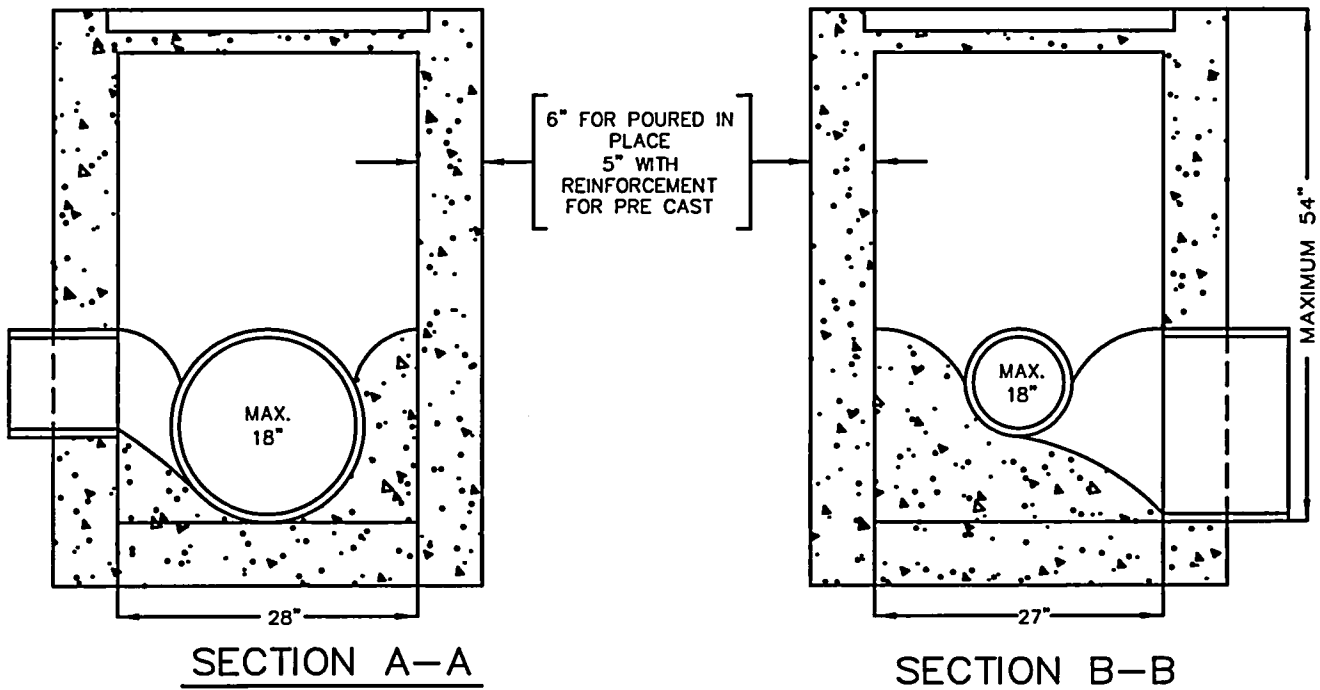
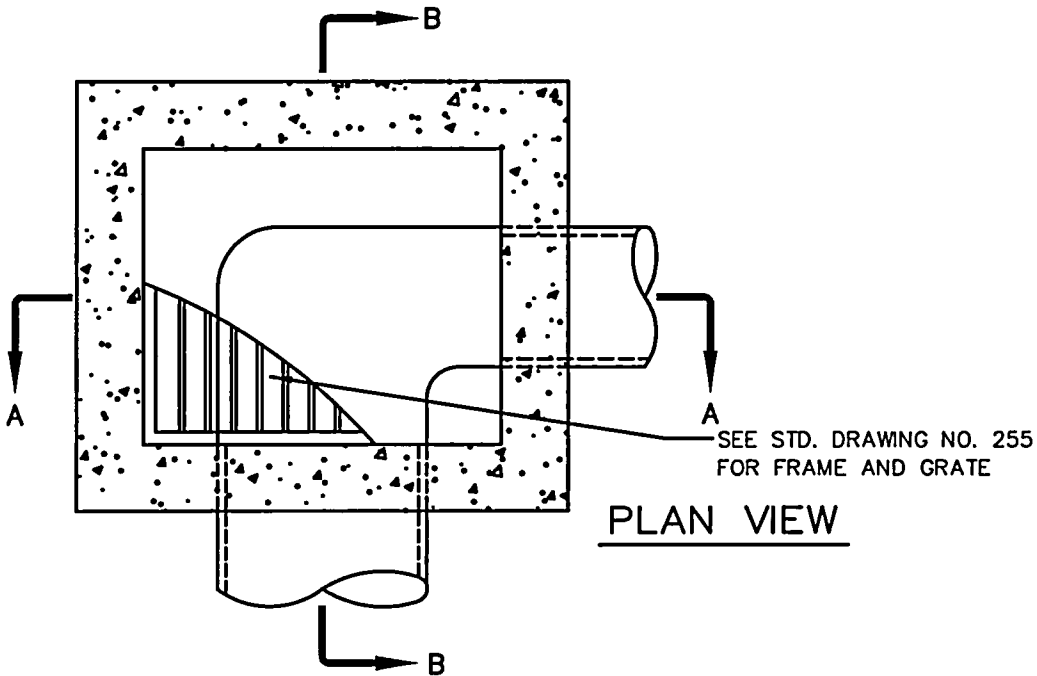
APPROVED FOR USE BY WASHINGTON COUNTY ONLY.

MODIFIED CURB INLET
 MANHOLE (MOD.CG-48MH)

DRAWING NO. 205

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NOTES:

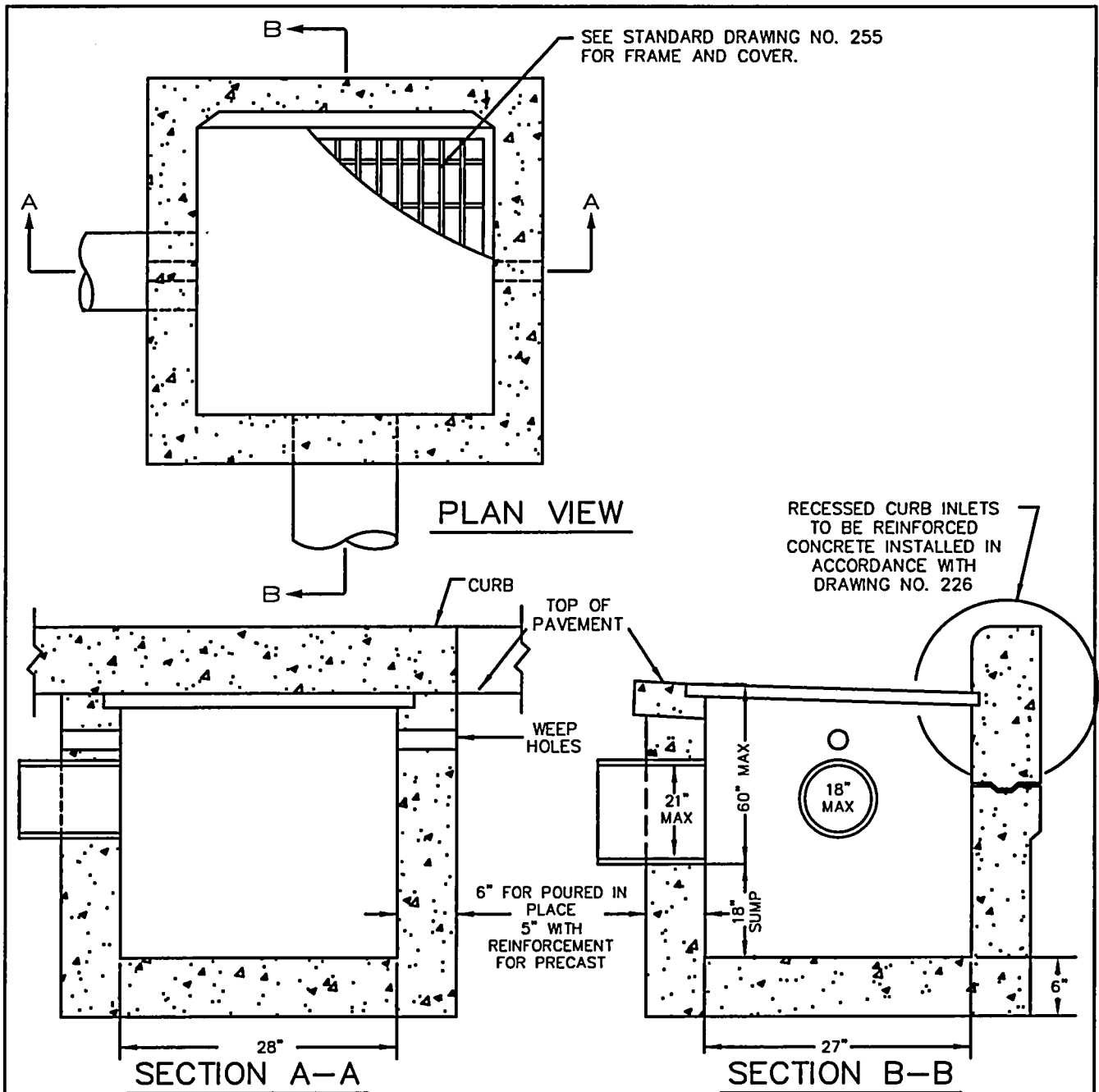
1. ALL PRE CAST SECTIONS SHALL CONFORM TO REQUIREMENTS OF ASTM C-478.
2. INSTALL STRUCTURE ON MIN. OF 8" OF $\frac{3}{4}$ "-0" COMPACTED BASE MATERIAL.
3. PRE CAST REINFORCEMENT SHALL BE REBAR MEETING ASTM A615 GRADE OR WELDED WIRE MEETING ASTM A497.
4. ALL POURED INPLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 P.S.I. AND A SLUMP OF 2" TO 4".
5. CHANNEL REQUIRED IN FLOW THROUGH APPLICATIONS, AS APPROVED. ALL OTHER APPLICATIONS REQUIRE AN 18" SUMP BELOW LOWEST PIPE INVERT.

AREA DRAIN
TYPE II

DRAWING NO. 220

REVISED 02-03

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NOTES:

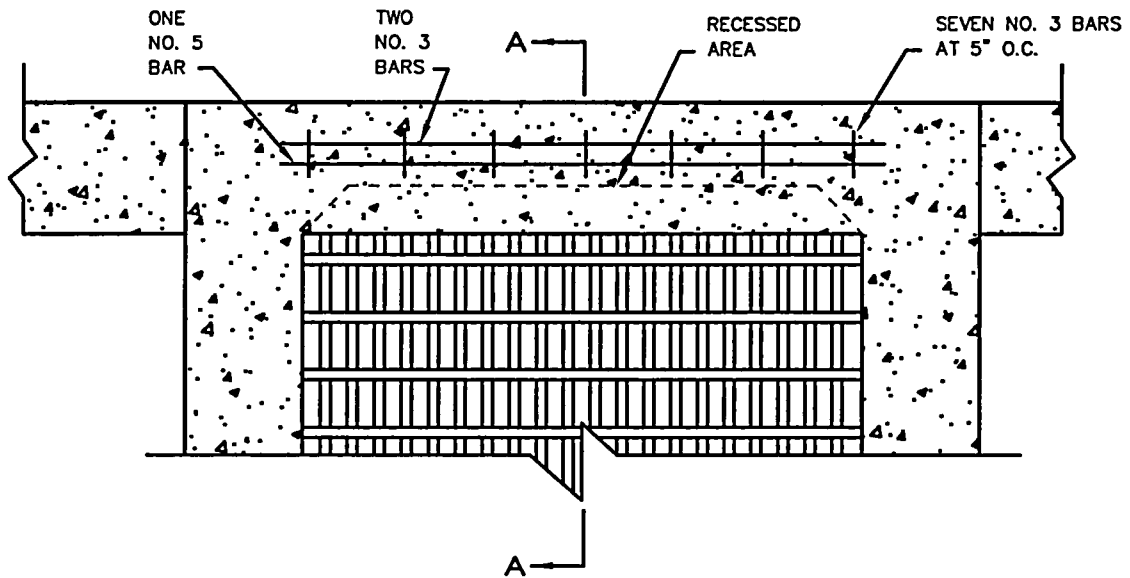
1. CATCH BASIN SHALL BE CONSTRUCTED IN ACCORDANCE WITH ASTM C-478.
2. INSTALL STEPS WHEN DISTANCE FROM TOP OF GRATE TO FLOWLINE OF PIPE IS GREATER THAN 48". SEE STANDARD DRAWING NO. 100. SET FIRST STEP 12" FROM TOP OF GRATE.
3. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4"-0" COMPACTED BASE MATERIAL.
4. REINFORCEMENT FOR PRECAST CATCH BASIN SHALL BE REBAR MEETING ASTM A-615 GRADE 60 OR WELDED WIRE MEETING ASTM A-497.
5. ALL POURED INPLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 P.S.I. AND A SLUMP OF 2" TO 4".
6. CHANNEL REQUIRED IN FLOW THROUGH APPLICATIONS, AS APPROVED. ALL OTHER APPLICATIONS REQUIRE AN 18" SUMP BELOW LOWEST PIPE INVERT.

GUTTER & CURB INLET CATCH BASIN (CG-2)

DRAWING NO. 225

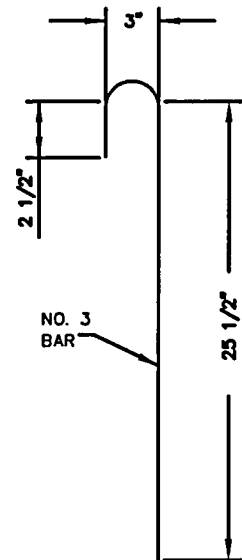
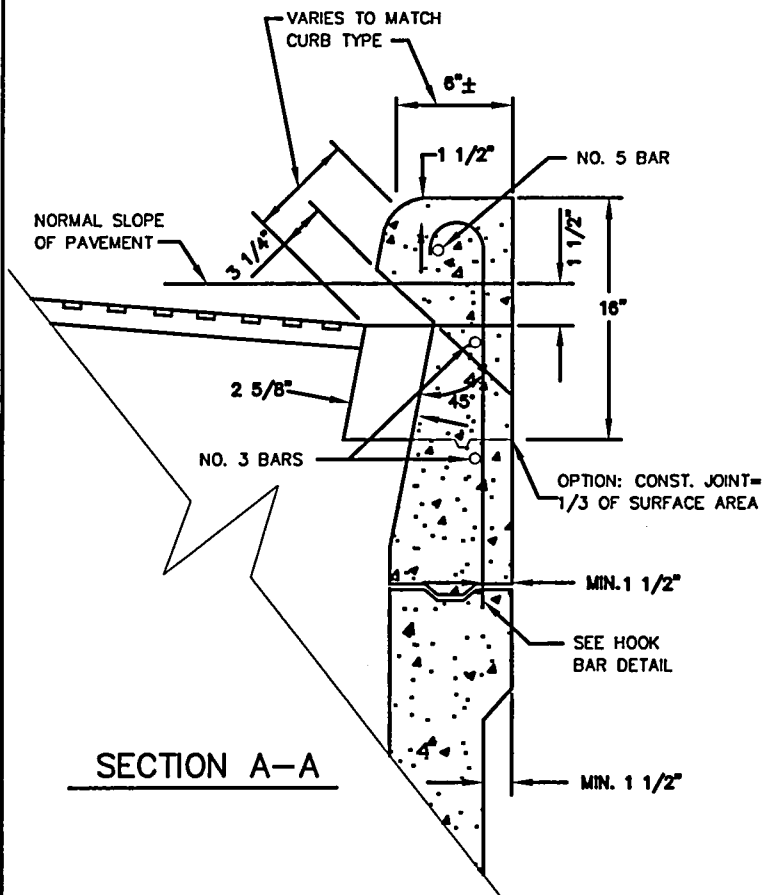
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PLAN

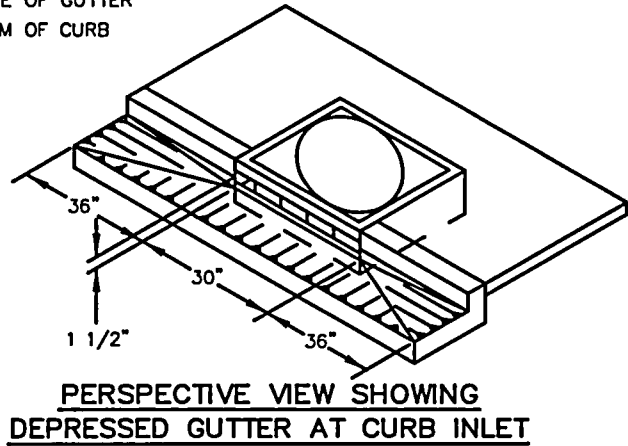
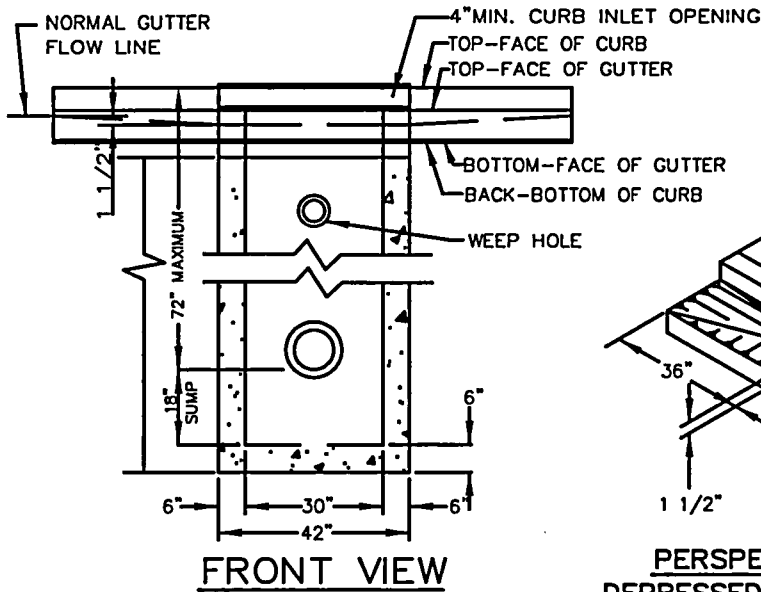
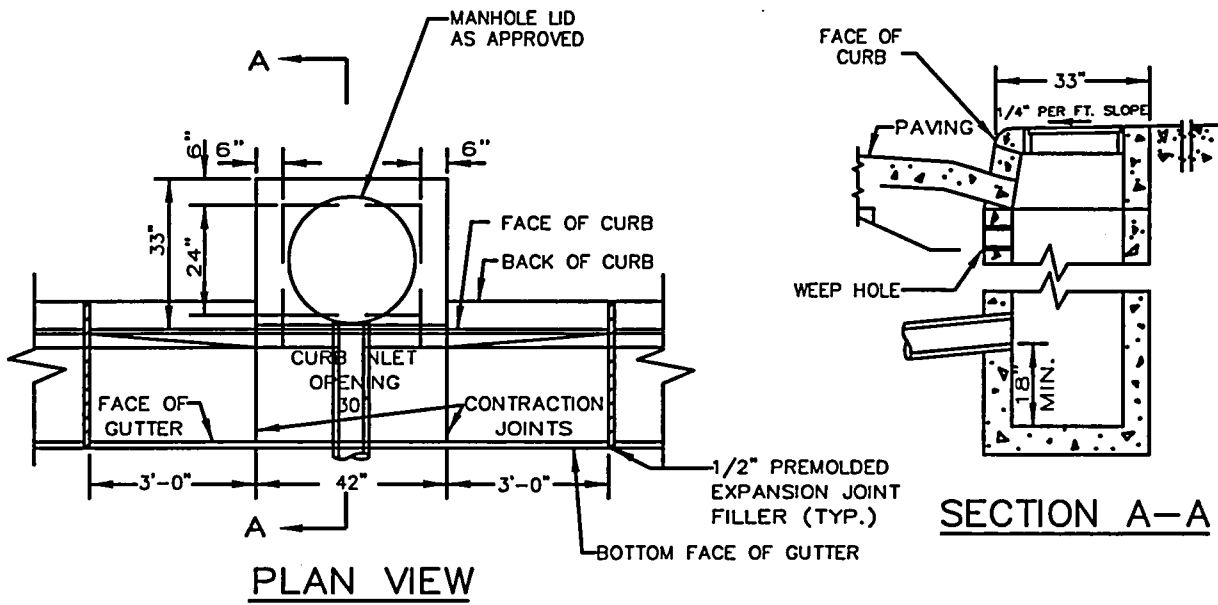
SEE STD DRAWING NO. 255
FOR FRAME AND COVER.



**GUTTER & CURB INLET CATCH
BASIN (CG-2) REINFORCEMENT**
DRAWING NO.226

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NOTES:

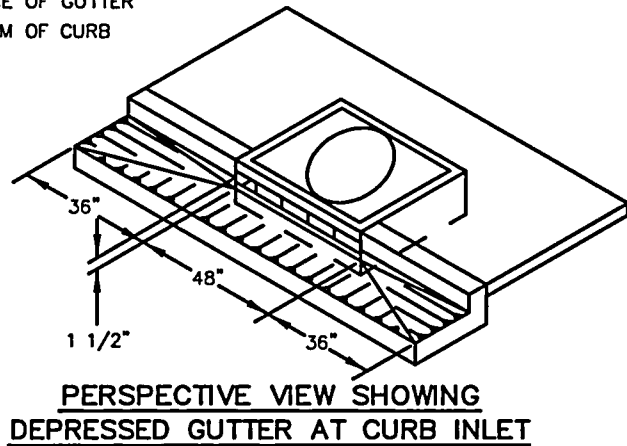
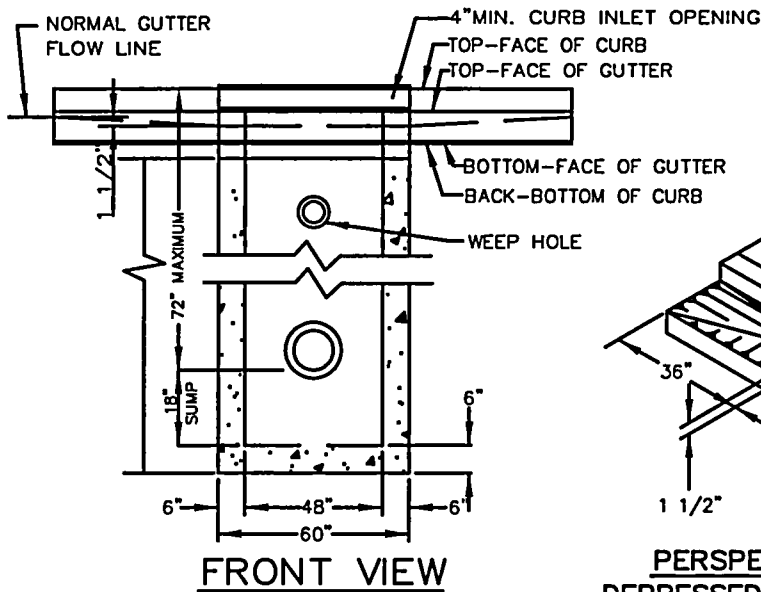
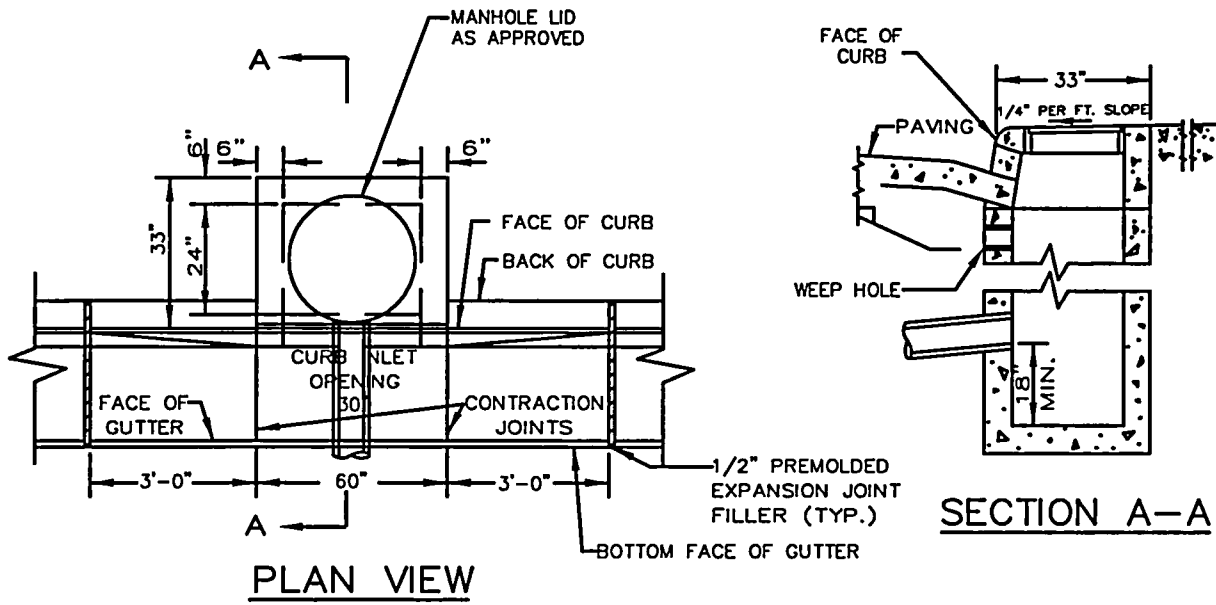
1. ALL FABRICATED METAL PARTS SHALL BE NEW STRUCTURAL, ASTM A-36 STEEL, AND BE HOT-DIPPED GALVANIZED AFTER FABRICATION.
2. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 P.S.I. AND A SLUMP OF 2" TO 4".
3. PRECAST CURB INLET IS PATTERNED AFTER WALT'S CONCRETE SPRINGFIELD, OR. CONCRETE CURB INLET PAT. NO. 4000953.
4. INSTALL STEPS WHEN DISTANCE FROM TOP OF LID TO FLOWLINE OF PIPE IS GREATER THAN 48" INCHES, SEE STD. DRAWING NO. 100. SET FIRST STEP 12" FROM TOP OF GRATE.
5. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4" TO 0" COMPACTED BASE MATERIAL.

**INLET
CATCH BASIN (CG-30)**

DRAWING NO. 230

REVISED 02-03





NOTES:

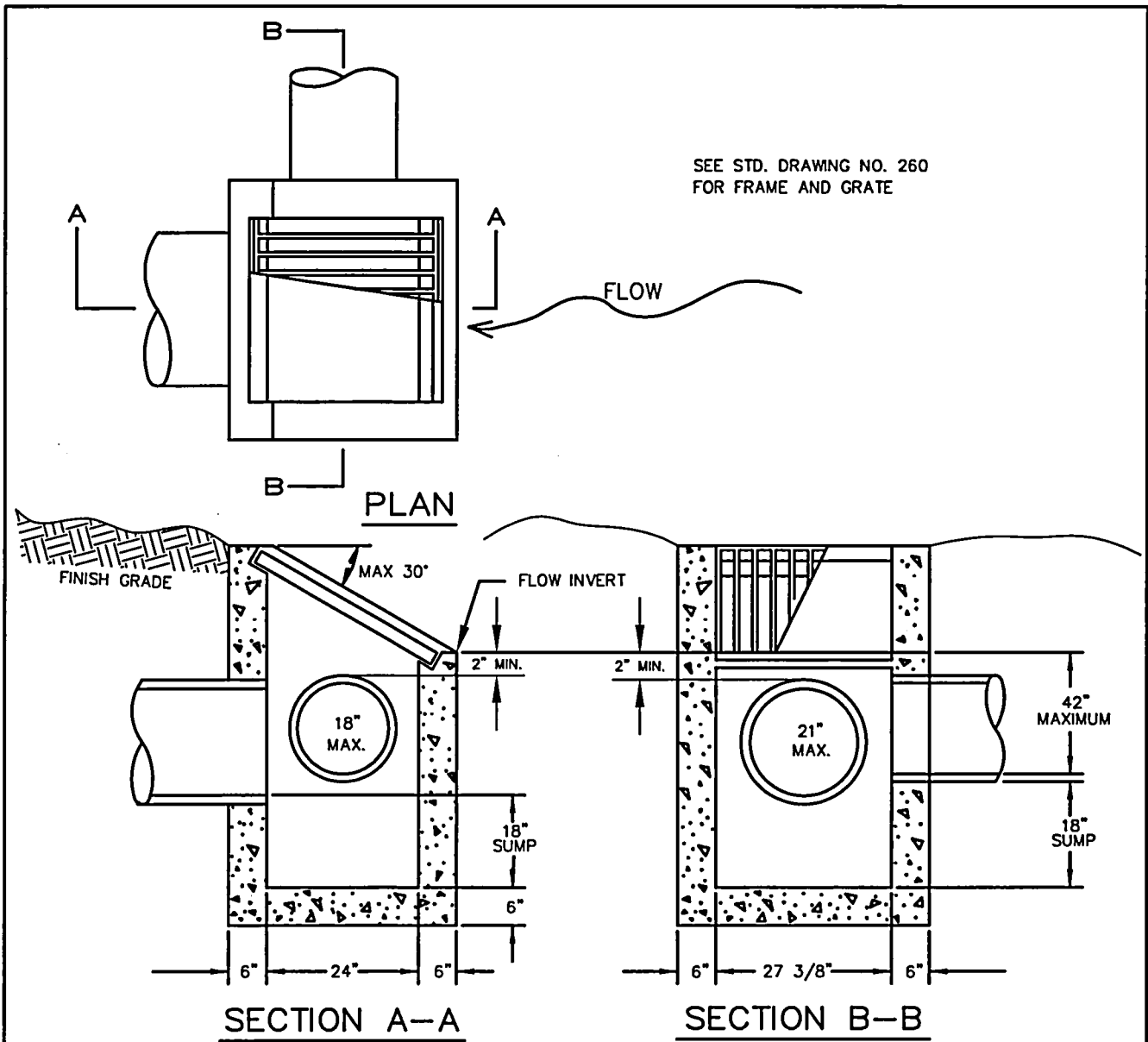
1. ALL FABRICATED METAL PARTS SHALL BE NEW STRUCTURAL, ASTM A-36 STEEL, AND BE HOT-DIPPED GALVANIZED AFTER FABRICATION.
2. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 P.S.I. AND A SLUMP OF 2" TO 4".
3. PRECAST CURB INLET IS PATTERNED AFTER WALT'S CONCRETE SPRINGFIELD, OR. CONCRETE CURB INLET PAT. NO. 4000953.
4. INSTALL STEPS WHEN DISTANCE FROM TOP OF LID TO FLOWLINE OF PIPE IS GREATER THAN 48" INCHES, SEE STD. DRAWING NO. 100. SET FIRST STEP 12" FROM TOP OF GRATE. AND ALIGN WITH LID OPENING.
5. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4" TO 0" COMPACTED BASE MATERIAL.

INLET
CATCH BASIN (CG-48)

DRAWING NO. 240

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NOTES:

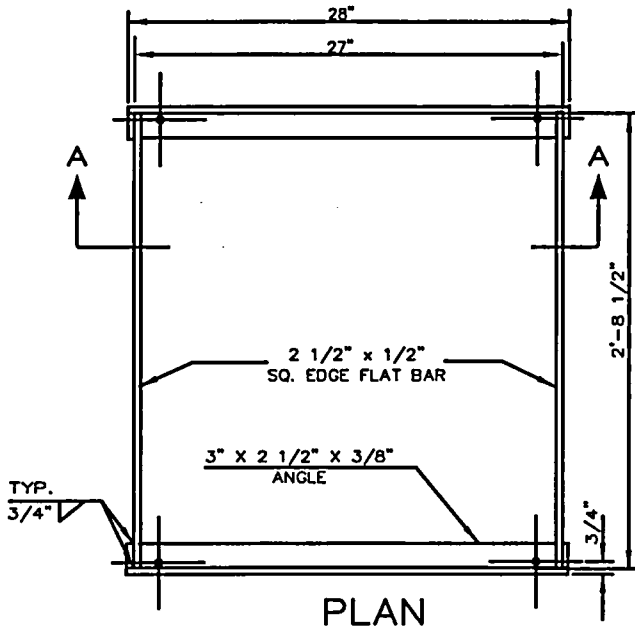
1. ALL PRE-CAST SECTIONS SHALL CONFORM TO REQUIREMENTS OF ASTM C-478.
2. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4" - 0" COMPACTED BASE MATERIAL.
3. PRECAST REINFORCEMENT SHALL BE REBAR MEETING ASTM A615 GRADE 60 OR WELDED WIRE MEETING ASTM A497
4. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI AND SLUMP OF 2" TO 4".

DITCH INLET

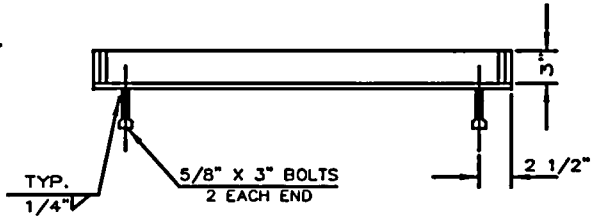
DRAWING NO. 250

REVISED 02-03

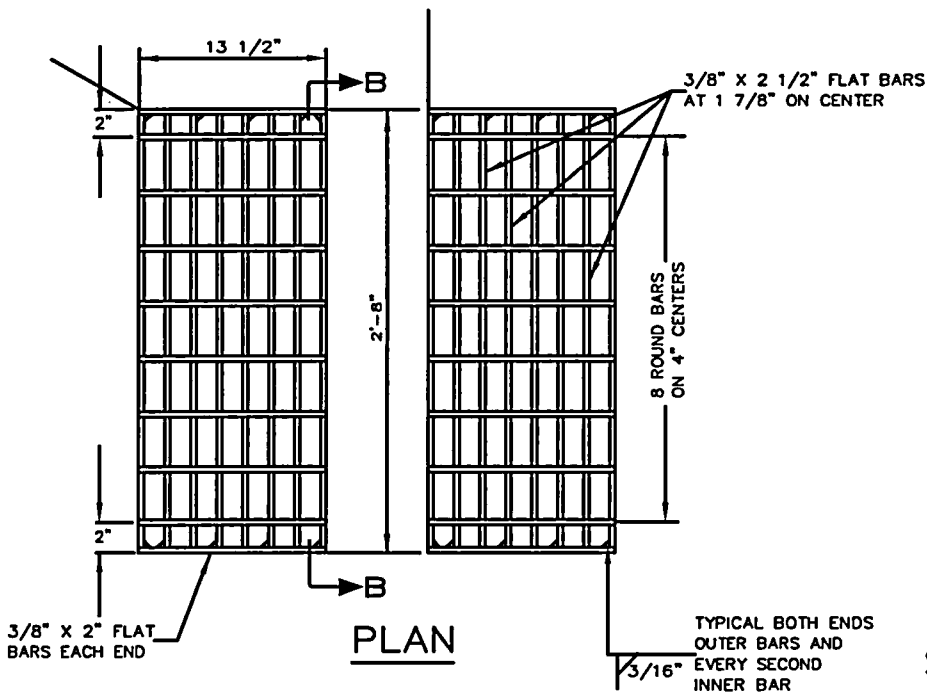
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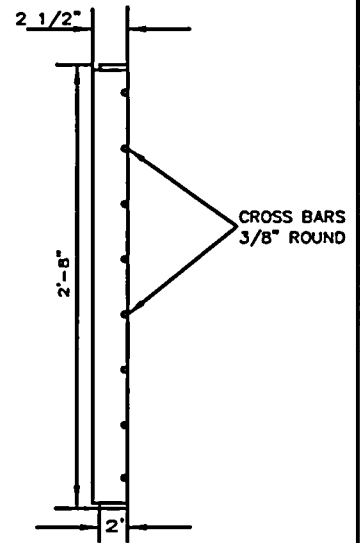
PLAN



SECTION A-A



PLAN



SECTION B-B

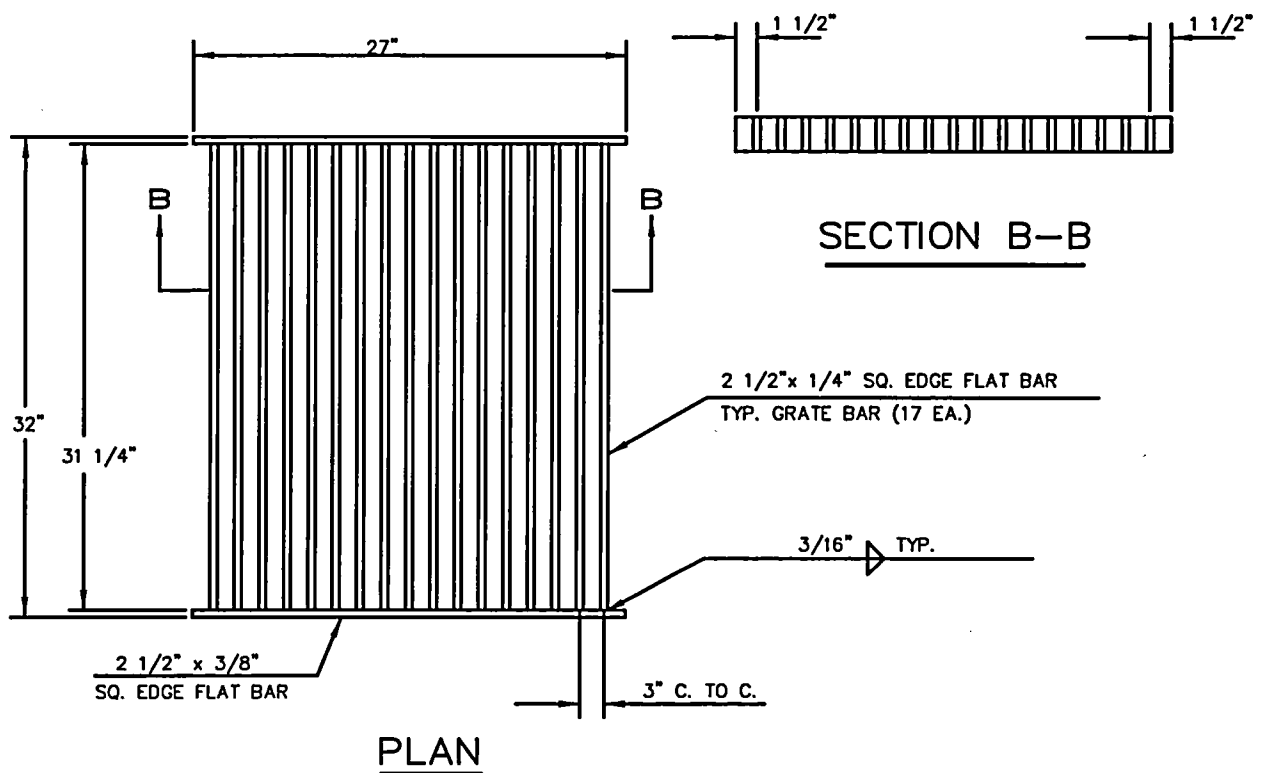
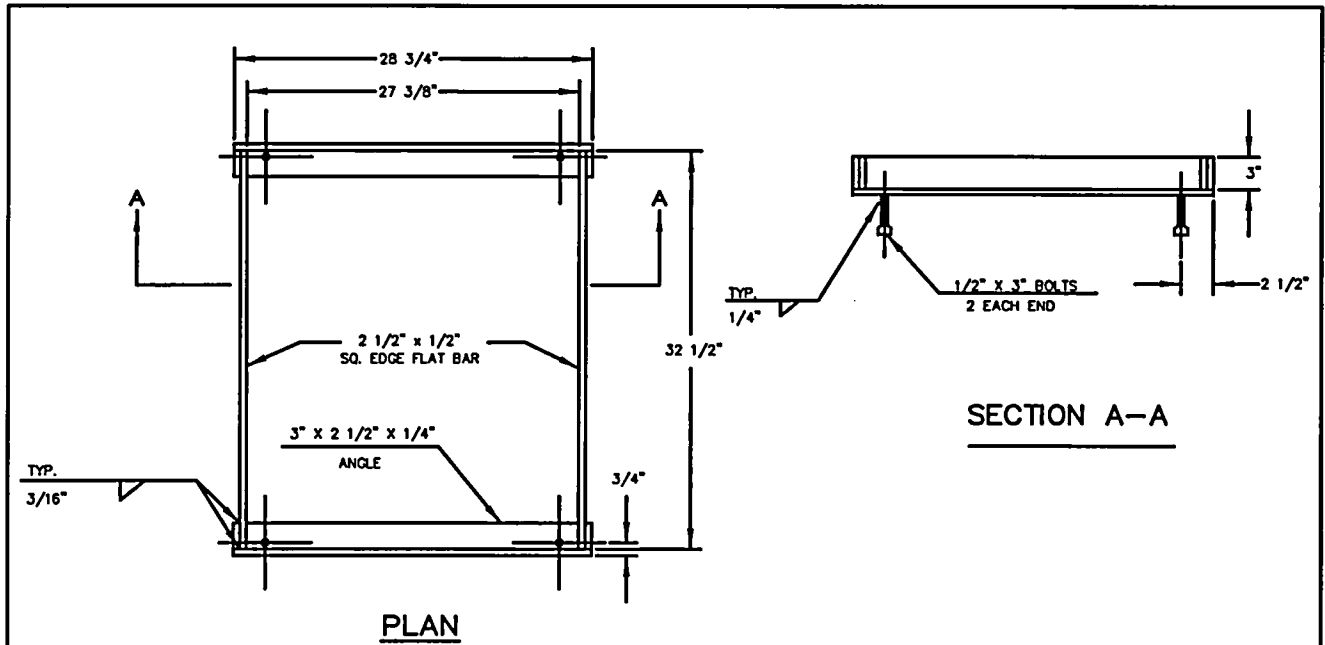
NOTE:
FRAME AND GRATE TO BE NEW STRUCTURAL ASTM A-36 FLAT BAR STEEL OR APPROVED EQUAL.
ADDITIONAL THICKNESS AND REINFORCEMENT SHALL BE REQUIRED FOR STATE HIGHWAY APPLICATIONS.

CATCH BASIN FRAME AND GRATE (L-G2)

DRAWING NO. 255

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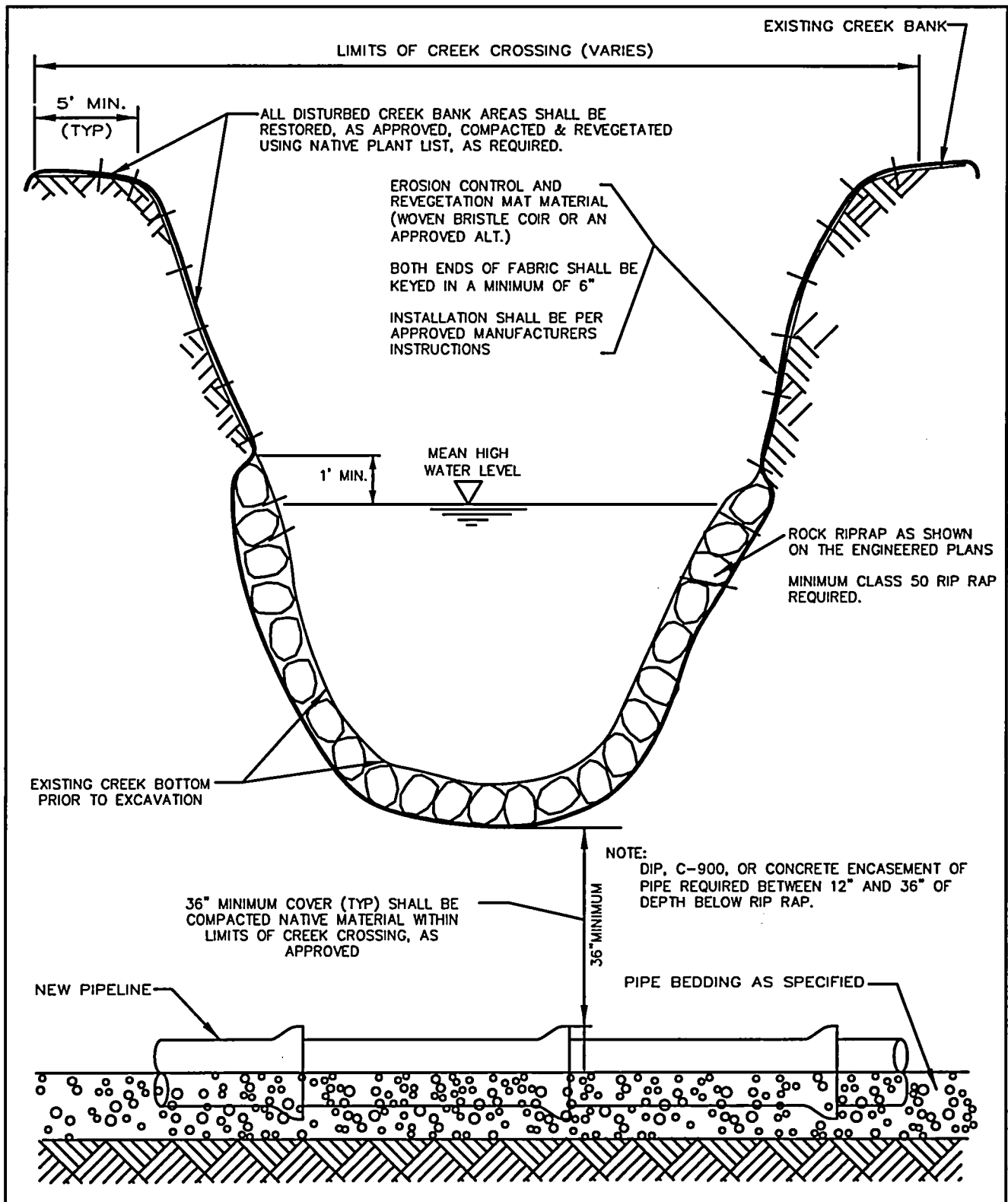
NOTE:
FRAME AND GRATE SHALL BE NEW STRUCTURAL ASTM A-36 FLAT BAR STEEL OR APPROVED EQUAL.

DITCH INLET FRAME AND GRATE

DRAWING NO. 260

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CREEK CROSSING RESTORATION

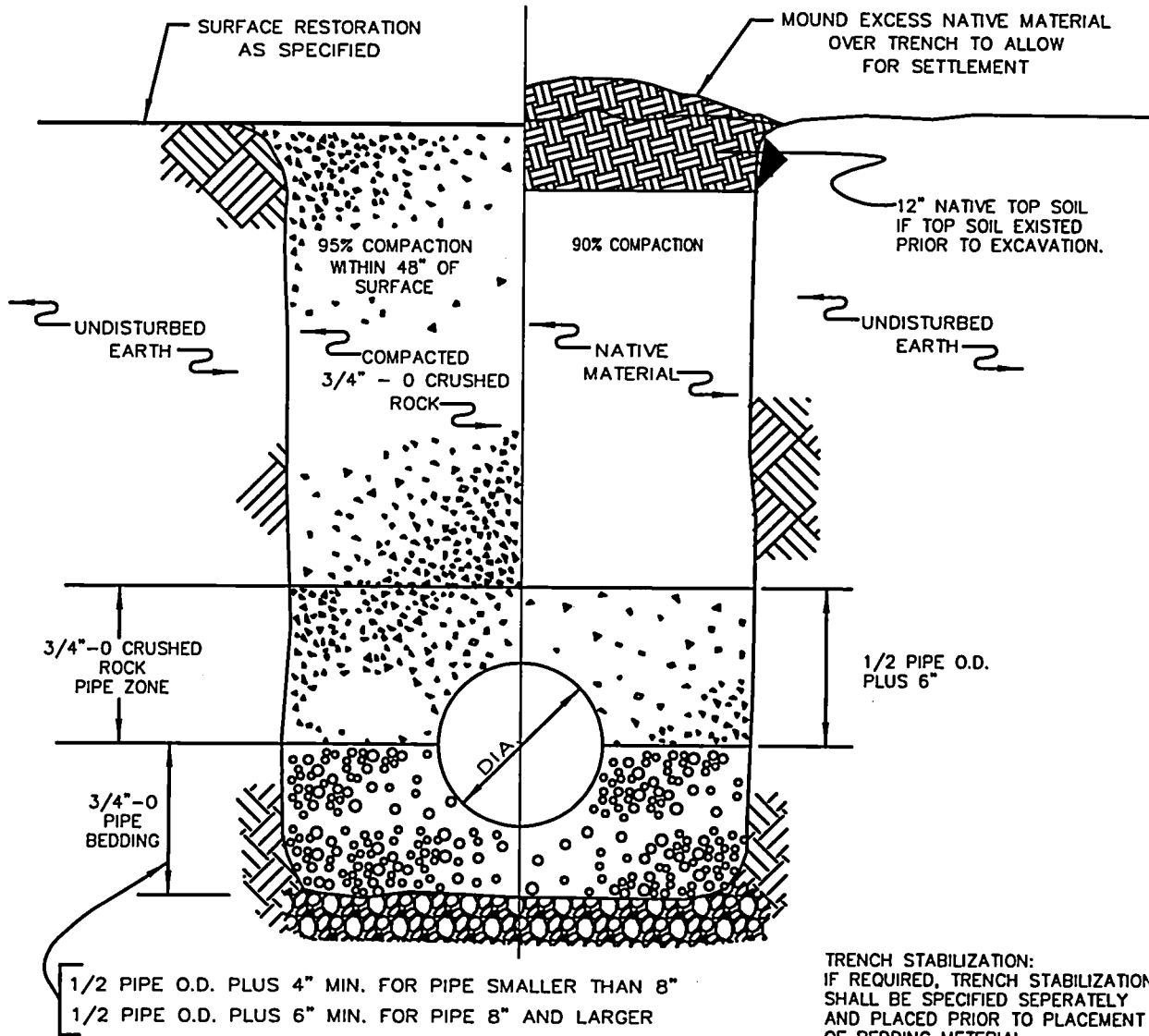
DRAWING NO. 270

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CLASS "B"

CLASS "A"



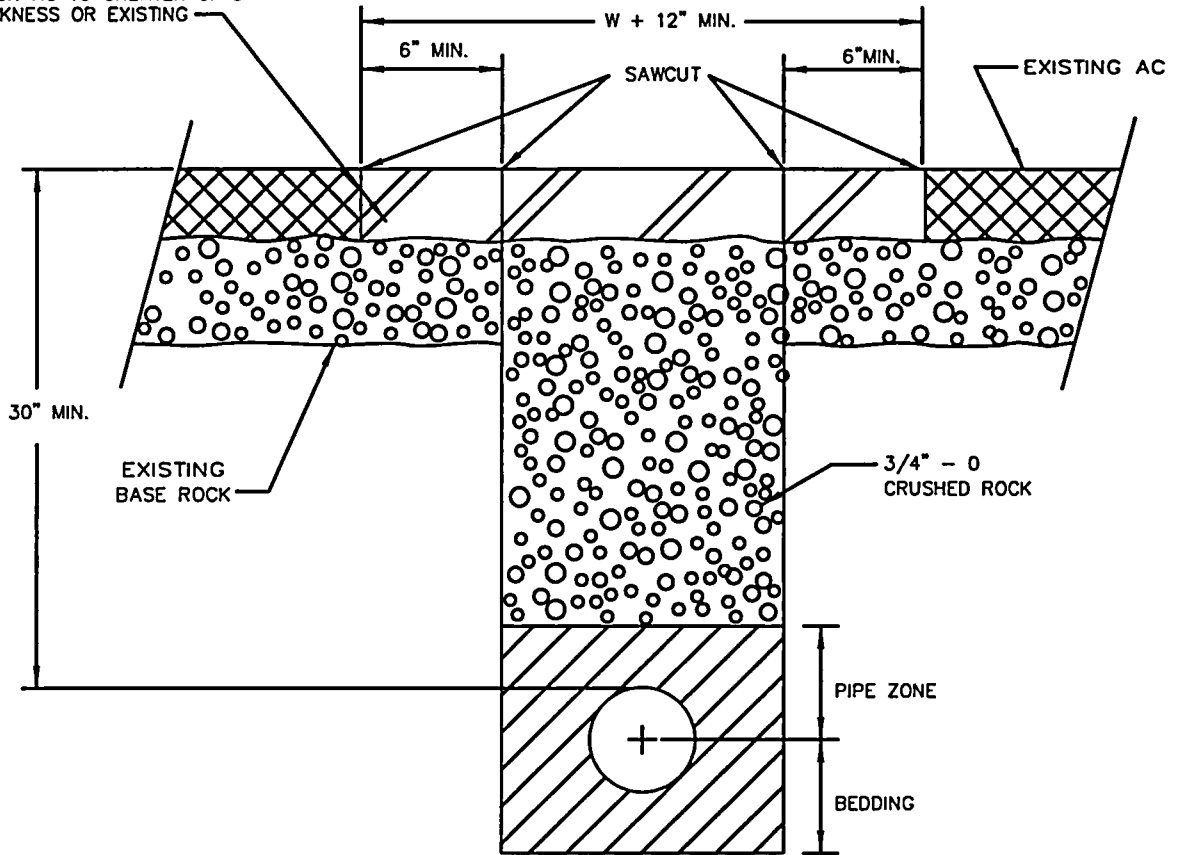
TRENCH BACKFILL DETAILS

DRAWING NO. 280

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TACK ALL EXPOSED MATERIAL
PATCH AC TO GREATER OF 3"
THICKNESS OR EXISTING



NOTE:

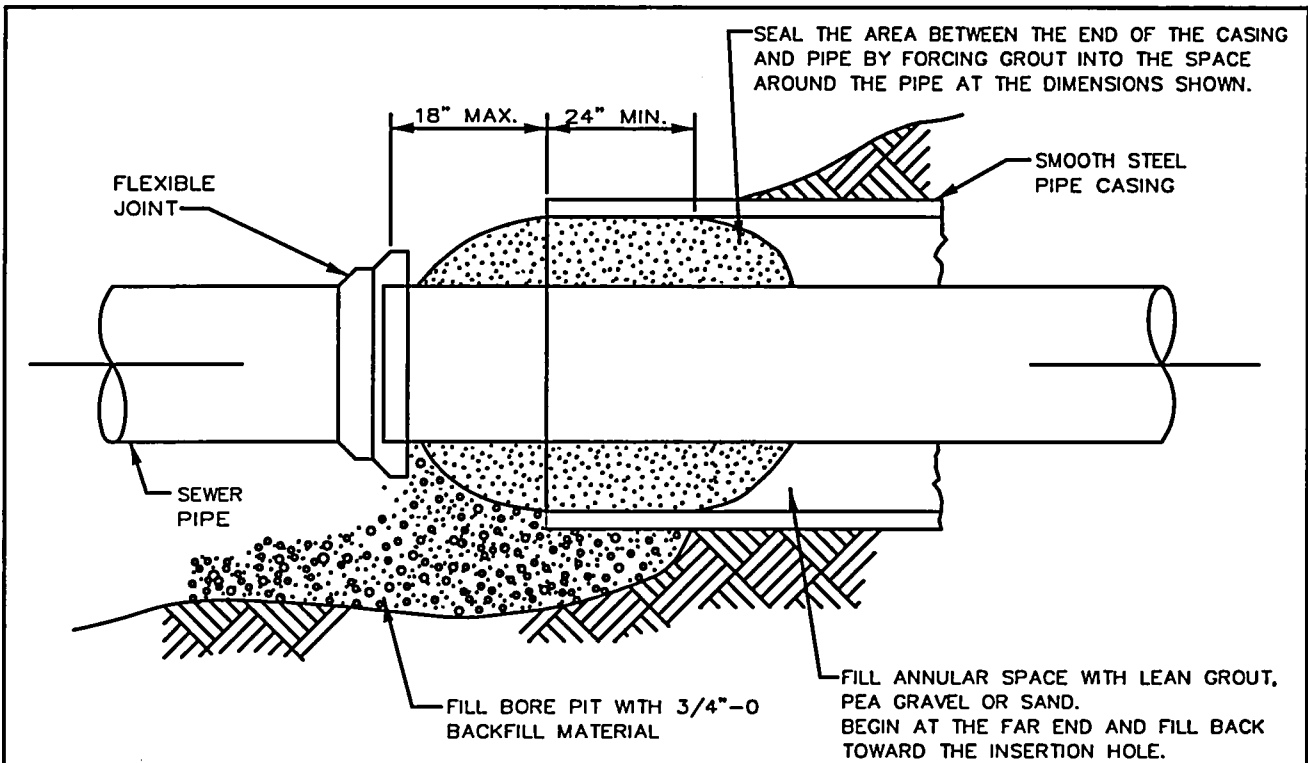
1. TEE CUT TO BE DONE AFTER EXCAVATION AND BACKFILL OF TRENCH.
2. SEE STD. DRAWING NO. 280 FOR BEDDING, PIPE ZONE, AND TRENCH BACKFILL.

T-CUT ASPHALT DETAILS

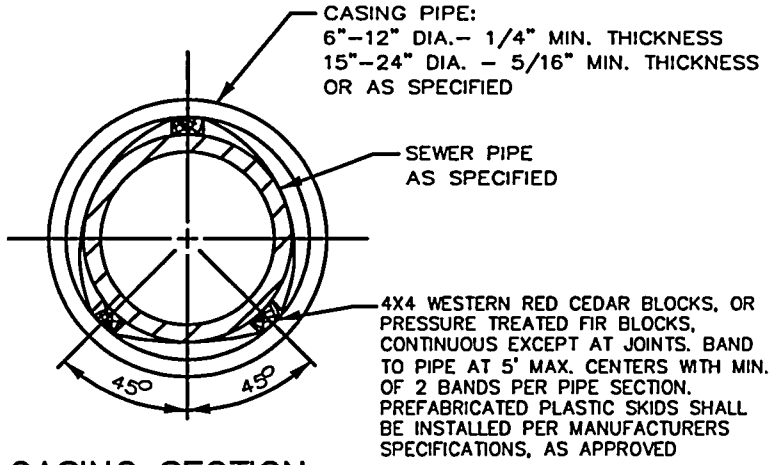
DRAWING NO. 285

REVISED 02-03

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PIPE SEAL DETAIL



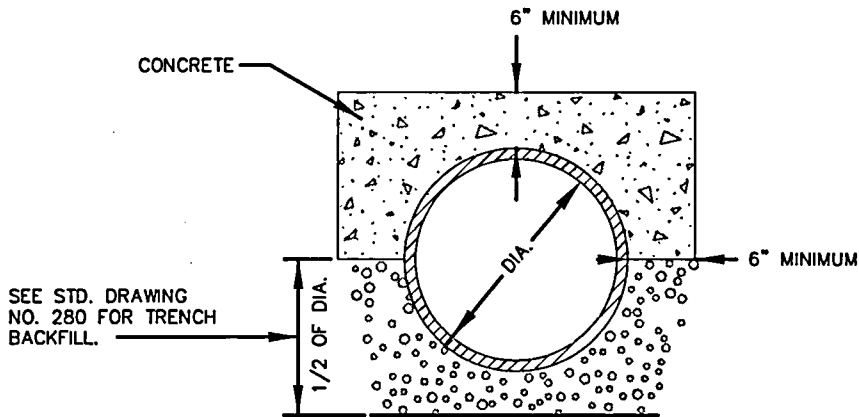
CASING SECTION

BORE DETAIL

DRAWING NO. 370

REVISED 02-03

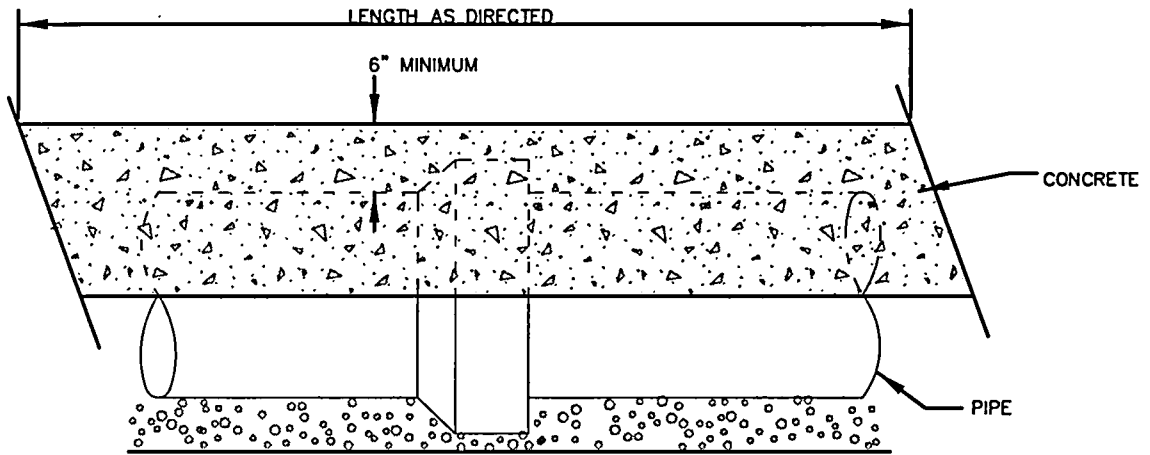




SEE STD. DRAWING
NO. 280 FOR TRENCH
BACKFILL.

END VIEW

NOTE:
CONCRETE SHALL HAVE A 28
DAY STRENGTH OF 3000 PSI
AND 2" TO 4" SLUMP.



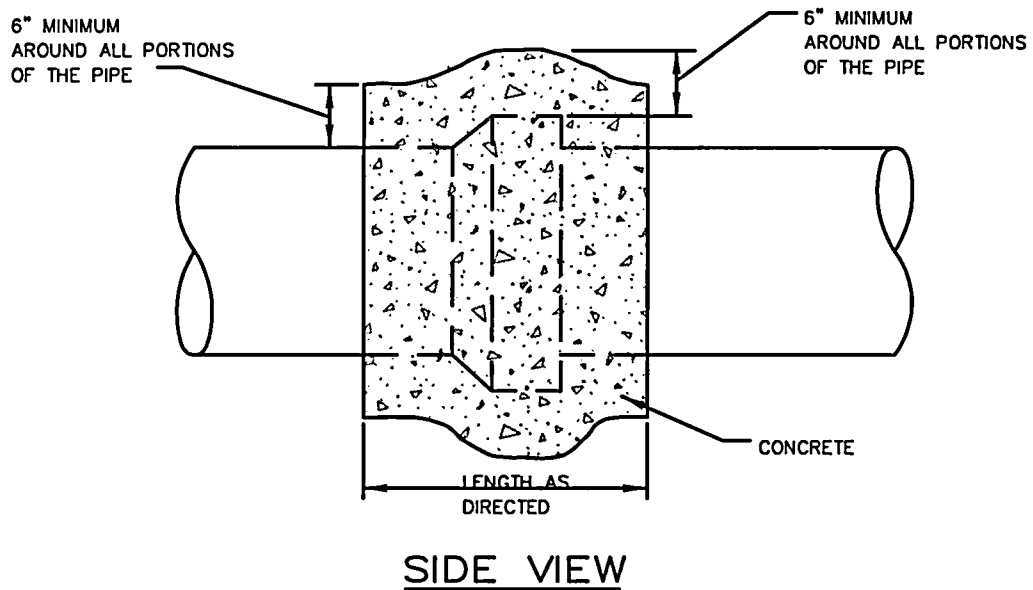
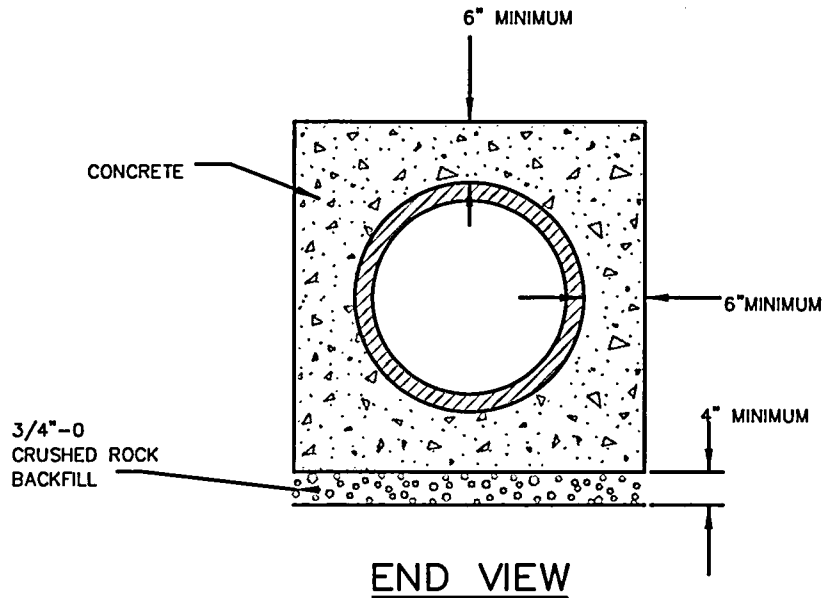
SIDE VIEW

CONCRETE CAP

DRAWING NO. 371

REVISED 02-03

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NOTE:
 CONCRETE SHALL HAVE A
 28 DAY STRENGTH OF 3000 PSI
 AND, 2" TO 4" SLUMP.

CONCRETE ENCASEMENT/ CLOSURE COLLAR

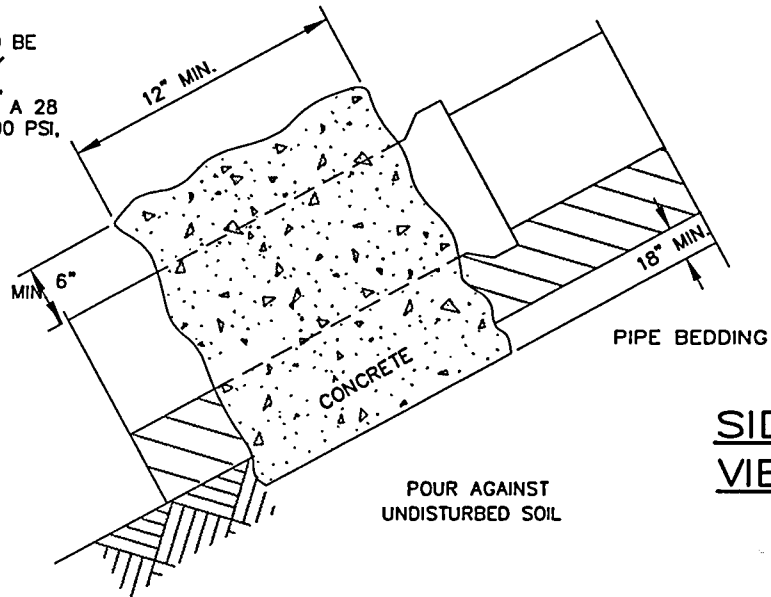
DRAWING NO. 372

REVISED 02-03

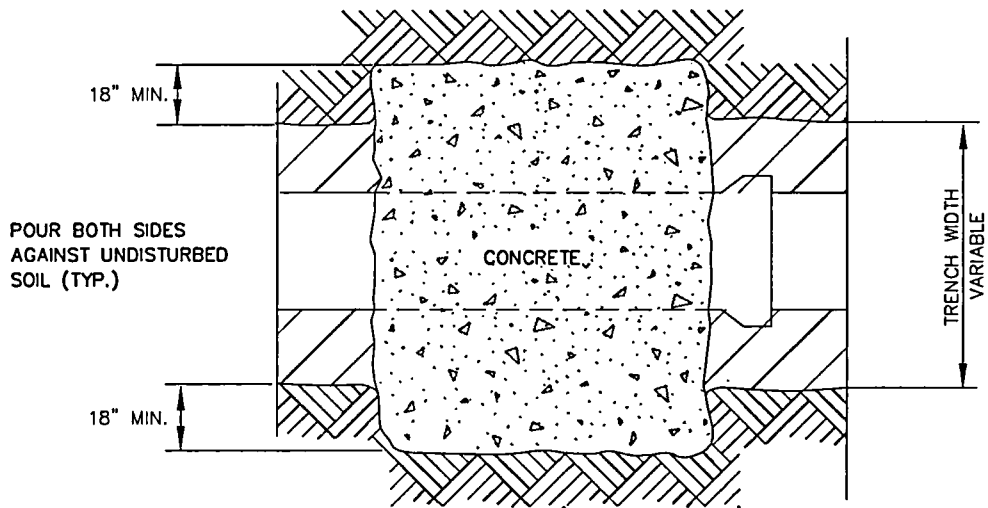
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NOTE:

1. CONCRETE ANCHORS TO BE INSTALLED IMMEDIATELY DOWNHILL OF PIPEBELL.
2. CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI, AND 2" TO 4" SLUMP.



SIDE
VIEW



PLAN

SLOPE	MIN. ANCHOR SPACING CENTER TO CENTER
20% - 34%	35'
35% - 50%	25'
51% +	15' OR CONC. ENCASEMENT

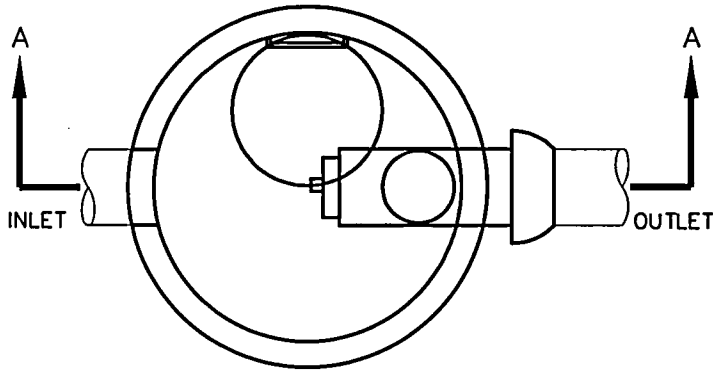
ODOT "METAL PIPE SLOPE ANCHORS" DWG # RD 330 IS ACCEPTABLE ALTERNATIVE

ANCHOR WALL

DRAWING NO. 373

REVISED 02-03





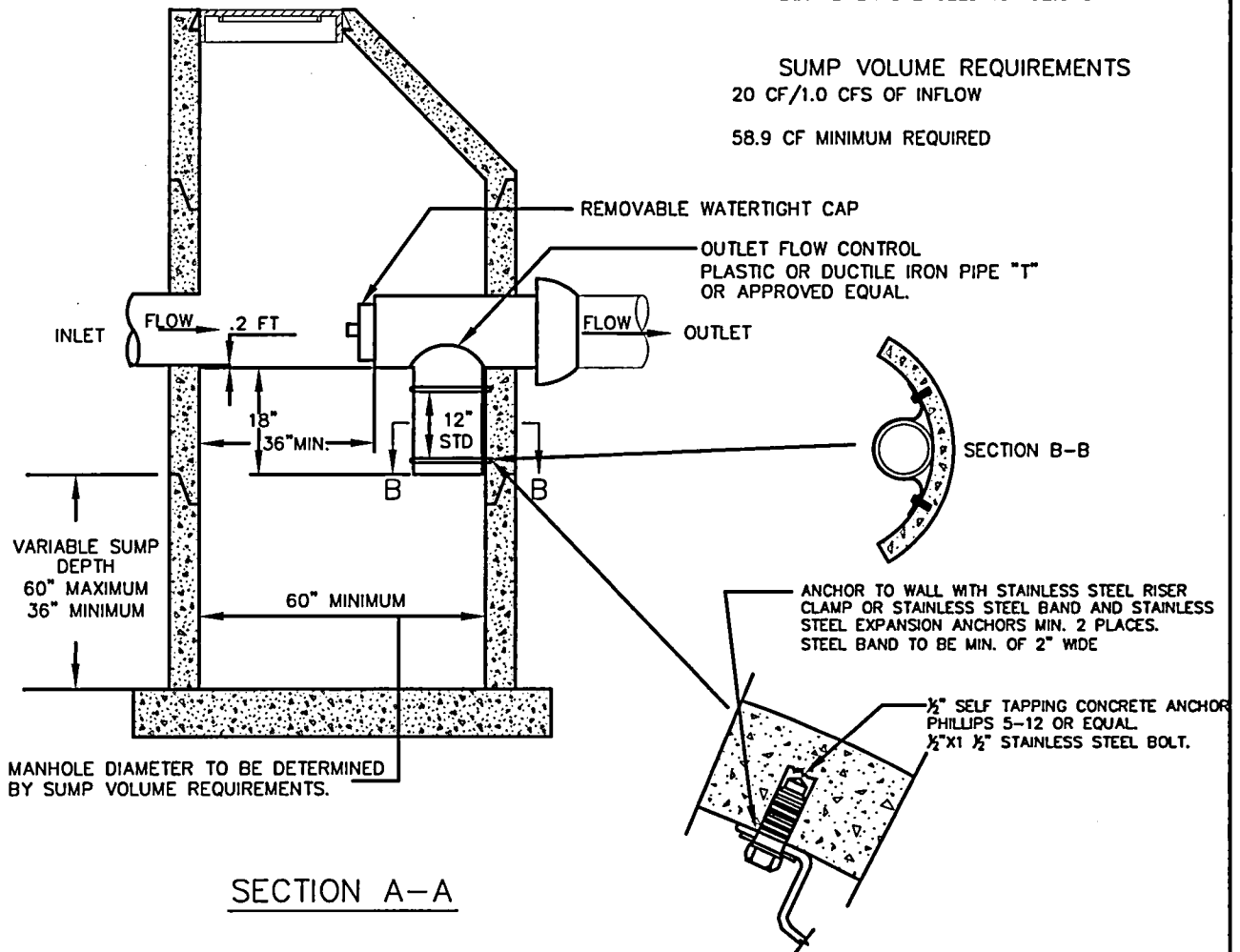
NOTES:

1. ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STD. MANHOLE DRAWING NO. 010
2. INLET AND OUTLET PIPE NOT TO EXCEED 18" DIA.
3. PROVIDE SPECIAL DETAIL FOR OUTLET FLOW CONTROL EXCEEDING 18" DIA.

SUMP VOLUME AVAILABLE		
	MINIMUM	MAXIMUM
60" M.H.=	58.9 CF	98.1 CF
72" M.H.=	84.8 CF	141.3 CF
84" M.H.=	115.4 CF	192.3 CF

PROVIDE SPECIAL DETAIL FOR VOLUME REQUIREMENTS EXCEEDING 192.3 CF

SUMP VOLUME REQUIREMENTS
 20 CF/1.0 CFS OF INFLOW
 58.9 CF MINIMUM REQUIRED



WATER QUALITY
 MANHOLE

DRAWING NO. 515

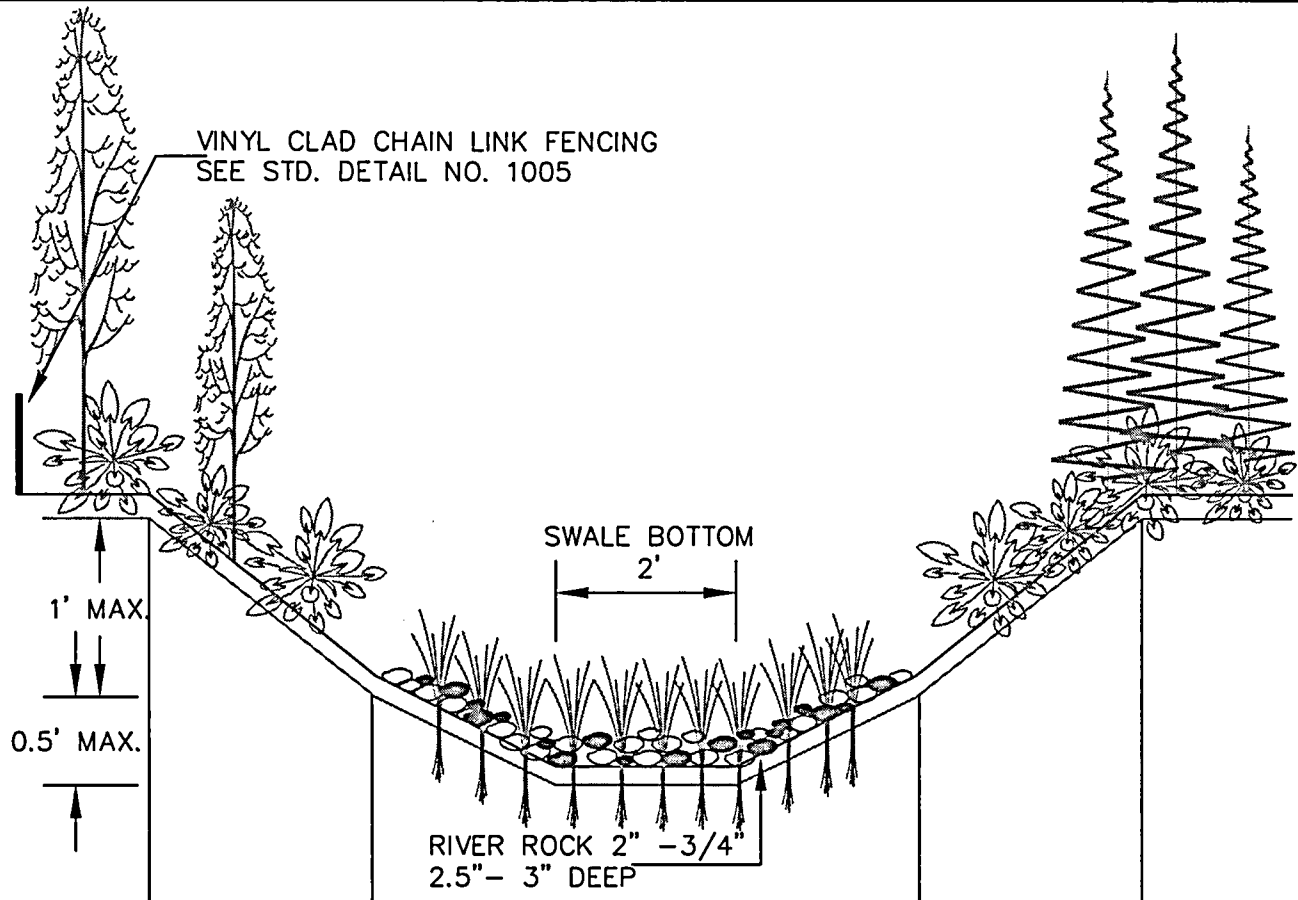
REVISED 09-03

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DRAWING NO. 520

WATER QUALITY SWALE

REVISED 12-03



SWALE AREA	FREEBOARD AREA	TREATMENT AREA 6' MINIMUM WIDTH	FREEBOARD AREA	BUFFER/MITIGATION AREA
EC MATTING	ECONOJUTE*	COCONUT FIBER OR GEOJUTE PLUS*	ECONOJUTE*	ECONOJUTE* (S > 20%)
SEED MIX	LOW GROW MIX	WET/MOIST MIX	LOWGROW MIX	UPLAND MIX
MAX. SLOPE	2.5:1	4:1	2.5:1	NA

* OR AS APPROVED

NOTES:

1. REFER TO APPENDIX D, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS APPROVED BY CWS.
3. JUTE MATTING- GEOJUTE PLUS IN TREATMENT AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILIAR FABRICS. COCONUT FIBER IS ALSO ACCEPTABLE.
4. 12-INCHES OF TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUALITY TRACT.



CONSTRUCTION

1. Water Quality Swale shall be over-excavated and filled to final grade with 12-inch amended topsoil. Topsoil amendments shall be garden compost, not conventional fertilizer amendments.
2. A biodegradable Erosion Control Matting shall be placed over the topsoil throughout the swale cross section, fabric shall be held in place in accordance with the manufacturer's installation requirements. Anchor spacing shall be based on 3 fps flow over the fabric.
 - a. Treatment area - high-density jute matting (Geojute Plus or other approved equal)
 - b. All other areas - low-density jute matting (EconoJute or other approved equal)
3. 2.5-3 inches of 2"- $\frac{3}{4}$ " river run rock shall be placed over the matting evenly throughout the length and width of the swale.
4. Plant materials shall be placed in accordance with the plan and plant table as shown on approved plans.
5. The water quality swale treatment area plantings can be deemed "substantially complete" once active green growth has occurred to an average growth of 3" and plant density is an average of approx. 6 plants (minimum 1-inch plugs or equivalent) per square foot.
6. The facility shall be deemed acceptable to begin the maintenance period when plant growth and density matches the engineer's design as shown on the approved plans and all other requirements have been met. The engineer must certify the facility to be functional, in accordance with the approved plan design to begin the two-year maintenance period.

MAINTENANCE

1. The permittee is responsible for the maintenance of this facility for a minimum of two years following construction and acceptance of this facility per Chapter 2.
2. Irrigation is to be provided per separate irrigation plan as approved.

Note: Irrigation needs are to be met using a temporary irrigation system with a timer during the dry season. Systems should be winterized during the wet season to assure longevity and guard against damage from freezing temperatures. Water source shall be as shown on the approved plans.
3. Engineer or Owners Representative is to visit and evaluate the site a minimum of twice annually (Spring and Fall). The landscaping shall be evaluated and replanted as necessary to ensure a minimum of 80% survival rate of the required vegetation and 90% aerial coverage. Non-native, invasive plant species shall be removed when occupying more than 20% of the site.
4. The facility shall be re-excavated and planted if siltation greater than 3 inches in depth occurs within the two-year maintenance period.

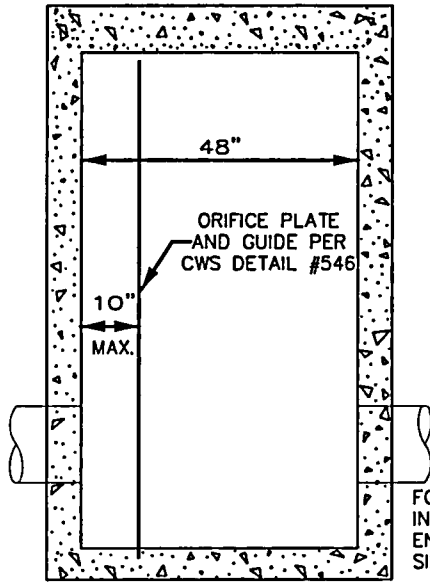
WATER QUALITY SWALE CONSTRUCTION & MAINTENANCE NOTES

DETAIL NO. 530

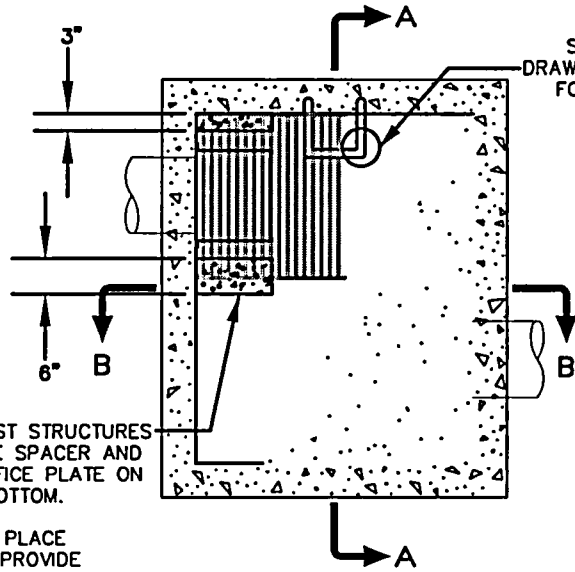
REVISED 12-03



SEE STD. DRAWING NO. 200
FOR TOP SECTION DETAILS



SECTION B-B



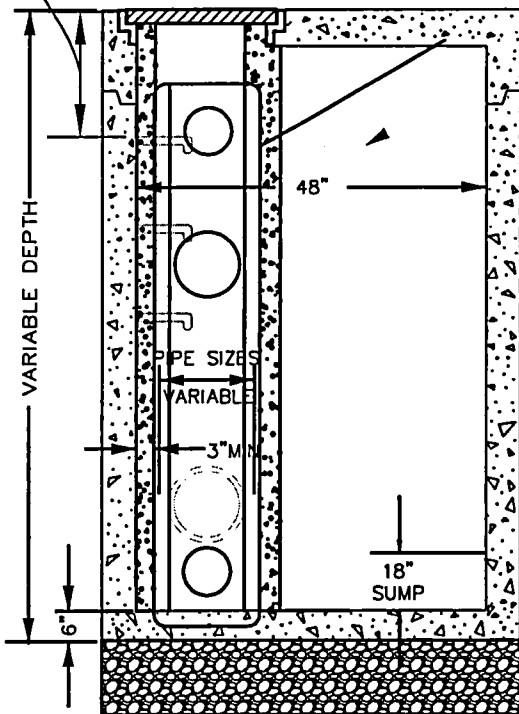
PLAN VIEW

SEE STD. DRAWING NO. 100
FOR STEPS

FOR PRE-CAST STRUCTURES
INSTALL HDPE SPACER AND
ENCLOSE ORIFICE PLATE ON
SIDES AND BOTTOM.

FOR CAST IN PLACE
STRUCTURES PROVIDE
CONCRETE SPACER FOR
MOUNTING FRAME.

MAXIMUM 27" FROM TOP OF FIRST
STEP TO TOP OF GRATE.



SECTION A-A

ORIFICE PLATE
AND GUIDE PER
CWS DETAIL #546

6" FOR POURED IN PLACE
5" WITH REINFORCEMENT FOR PRE-CAST

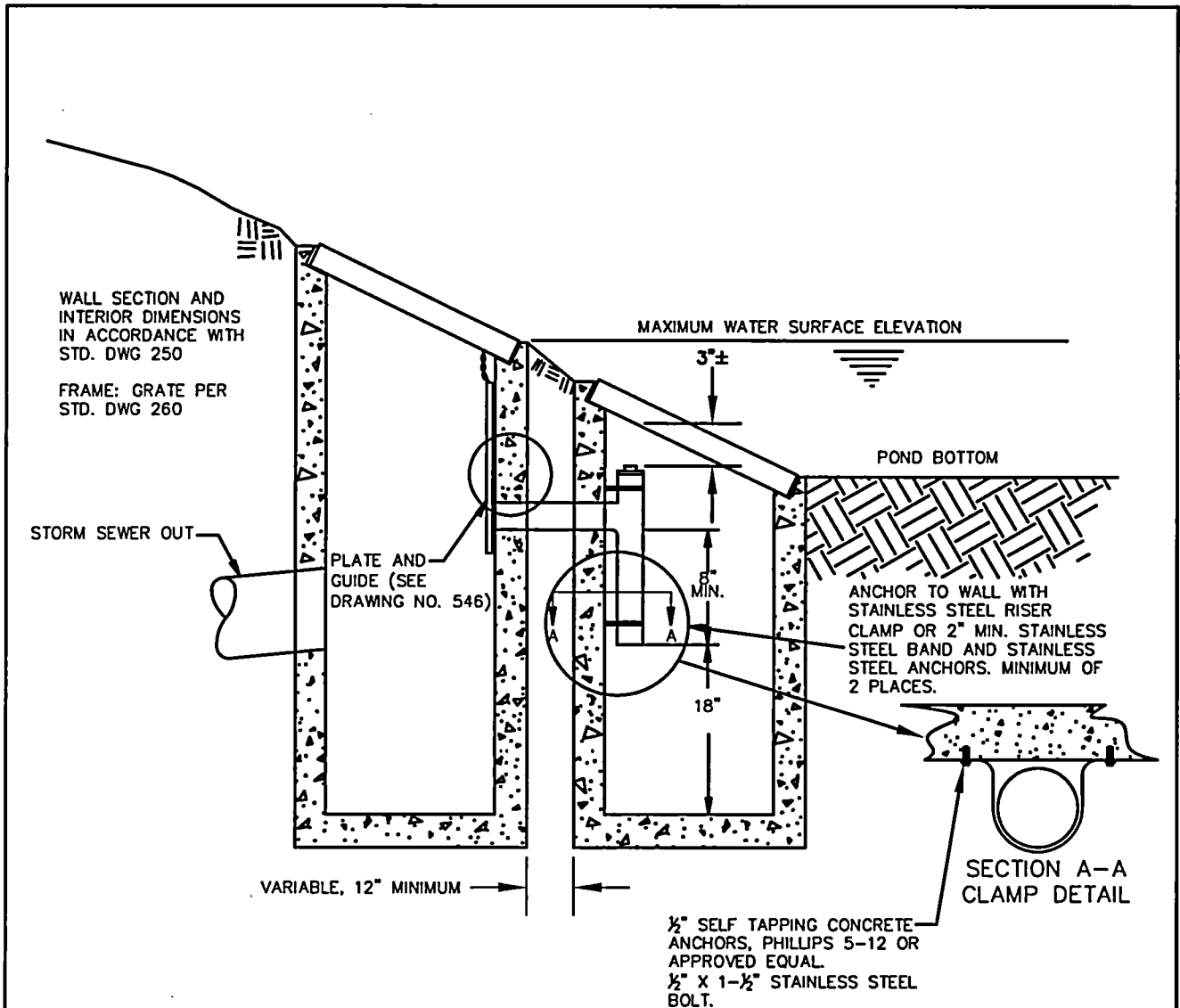
NOTES:

1. THIS IS AN ALTERNATE DESIGN FOR THE SECONDARY STRUCTURE IN OUTFLOW CONTROL STRUCTURE- CWS DETAIL #545
2. PRECAST CATCH BASIN SHALL BE CONSTRUCTED IN ACCORDANCE WITH ASTM C-478.
3. NON-SUMP INLET MANHOLE SHALL BE CHanneled.
4. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI. AND A SUMP OF 2" TO 4"
5. ORIFICE I.E. TO BE SHOWN ON PLAN SET. ORIFICE DESIGN TO BE OUTLINED IN DRAINAGE REPORT.

10" MINIMUM OF ¾" TO 0" COMPACTED BASE MATERIAL.

ALTERNATIVE OUTFLOW CONTROL STRUCTURE
(MODIFIED CG-48 M.H.)

DRAWING NO. 544



NOTES:

1. CONNECTING PIPE AND TEE SHALL BE 4", 6", OR 8" AWWA C-900 OR ASTM 3034 PVC, AND ONE SIZE LARGER THAN THE ORIFICE OPENING.
2. MAXIMUM ORIFICE OPENING SHALL BE 6" DIAMETER.
3. STRUCTURES SHALL CONFORM TO STANDARD DRAWING NO. 259 DITCH INLET.
4. FRAME AND GRATE SHALL CONFORM TO STANDARD DRAWING NO. 260, DITCH INLET FRAME AND GRATE.
5. PLATE AND GUIDE SHALL BE SECURED FLUSH AGAINST WALL OF STRUCTURE AS APPROVED.

OUTFLOW CONTROL STRUCTURE

DRAWING NO. 545

REVISED 02-03


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SLOT SHALL BE 1"X5" CENTERED

3/16" STAINLESS STEEL CHAIN OR CABLE ATTACHED TO ORIFICE PLATE AND STRUCTURE AS APPROVED. CHAIN OR CABLE SHALL BE SMALL ENOUGH TO ALLOW ORIFICE PLATE TO BE REMOVED FROM GUIDE. 1/2" HDPE, OR 1/4" STAINLESS STEEL ORIFICE PLATE OR APPROVED EQUAL.

ORIFICE SIZE AS SHOWN ON THE PLANS. ALIGN INVERT OF ORIFICE TO INVERT OF PIPE.

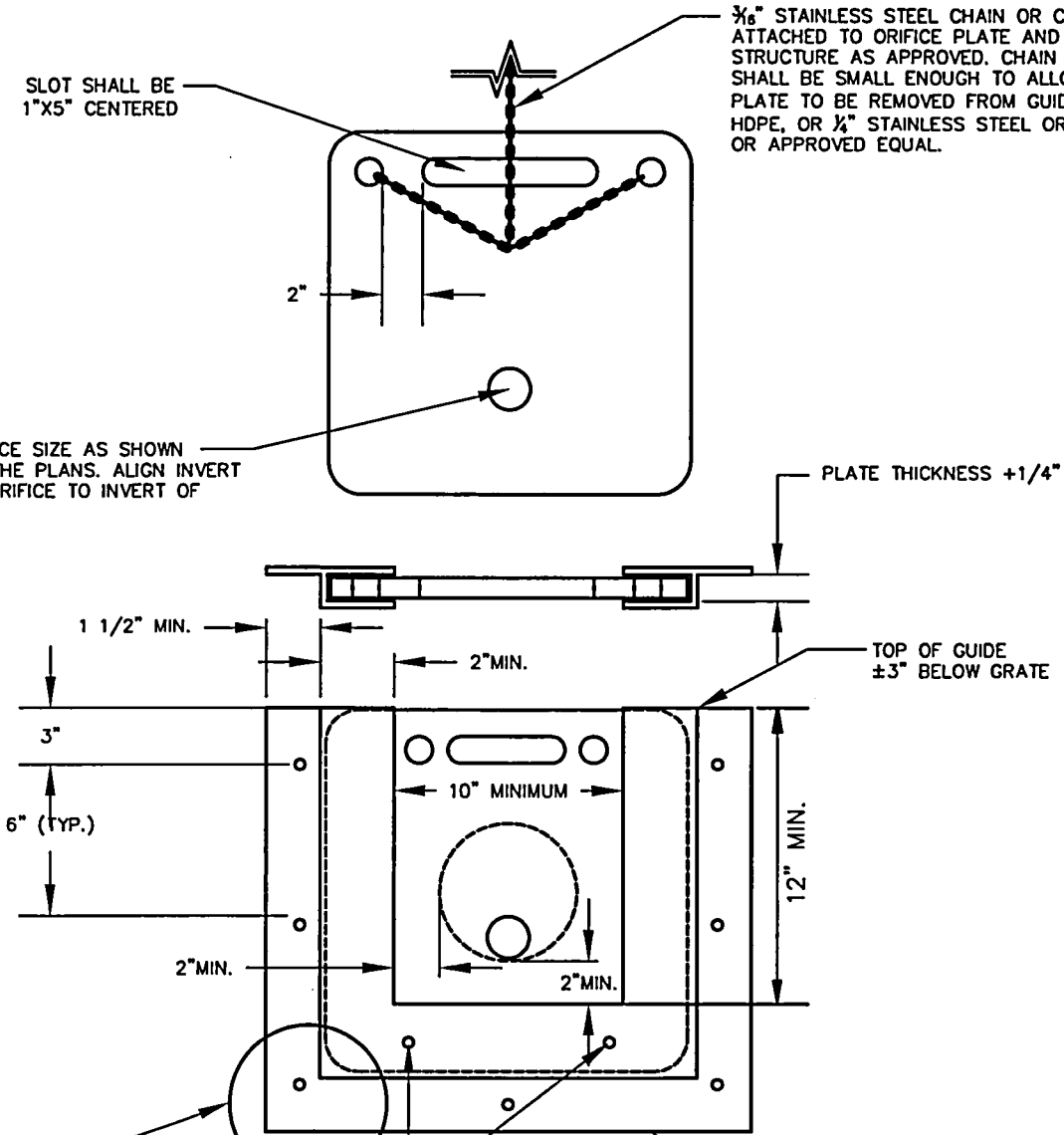


PLATE THICKNESS +1/4"

TOP OF GUIDE ±3" BELOW GRATE

1/2" DIA. WEEPHOLES

ORIFICE PLATE GUIDE SHALL FIT STOP GATE AND INCLUDE BOTTOM CHANNEL ORIFICE PLATE GUIDE.

ORIFICE PLATE GUIDE SHALL BE SHOP FABRICATED STAINLESS STEEL.

1/2" SELF TAPPING CONCRETE ANCHORS, PHILLIPS 5-12 OR APPROVED EQUAL.
1/2" X 1-1/2" STAINLESS STEEL BOLT.

ORIFICE PLATE AND GUIDE

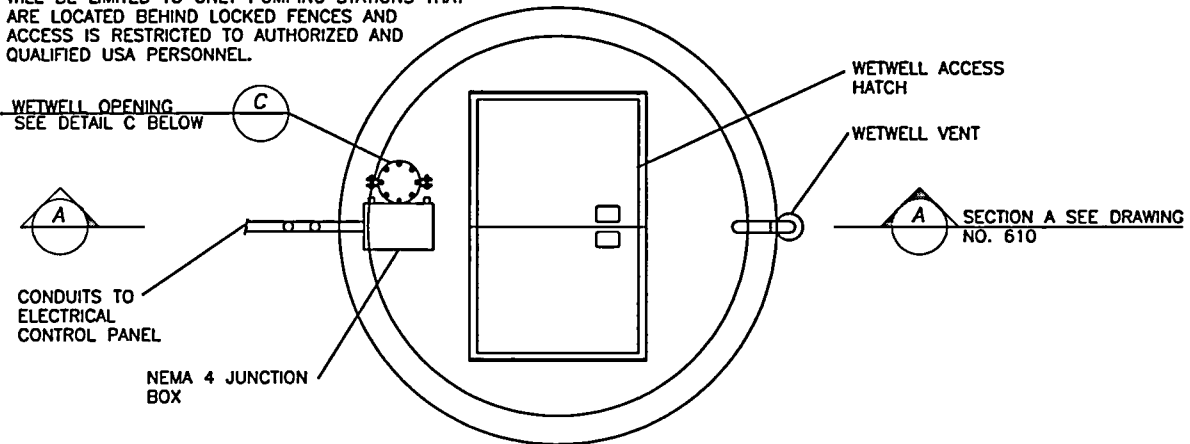


DRAWING NO. 546

REVISED 02-03

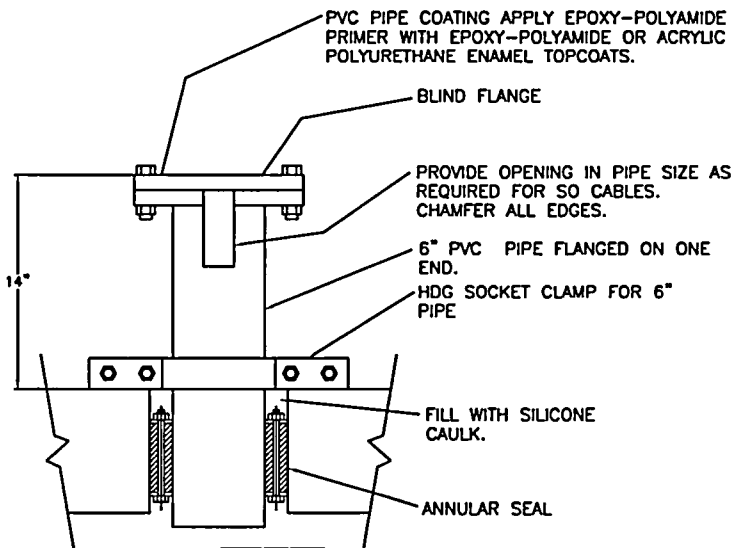
NOTES:

1) JUNCTION BOX SHALL BE LOCATED ENTIRELY OUTSIDE THE CONFINES OF THE CLASS 1, DIVISION 1 AREA OF THE WETWELL. WHERE AREAS OF AROUND THE PUMPING STATION ARE LOCATED OUTDOORS; THERE IS FREE MOVEMENT AND UNIMPEDED AIR CIRCULATION. THIS INSTALLATION WILL BE LIMITED TO ONLY PUMPING STATIONS THAT ARE LOCATED BEHIND LOCKED FENCES AND ACCESS IS RESTRICTED TO AUTHORIZED AND QUALIFIED USA PERSONNEL.



PUMPSTATION PLAN VIEW

NTS



NOTE: USE STAINLESS STEEL HARDWARE.

DISTANCE AS REQUIRED BY ANNULAR SEAL MANUFACTURER

WETWELL OPENING DETAIL C

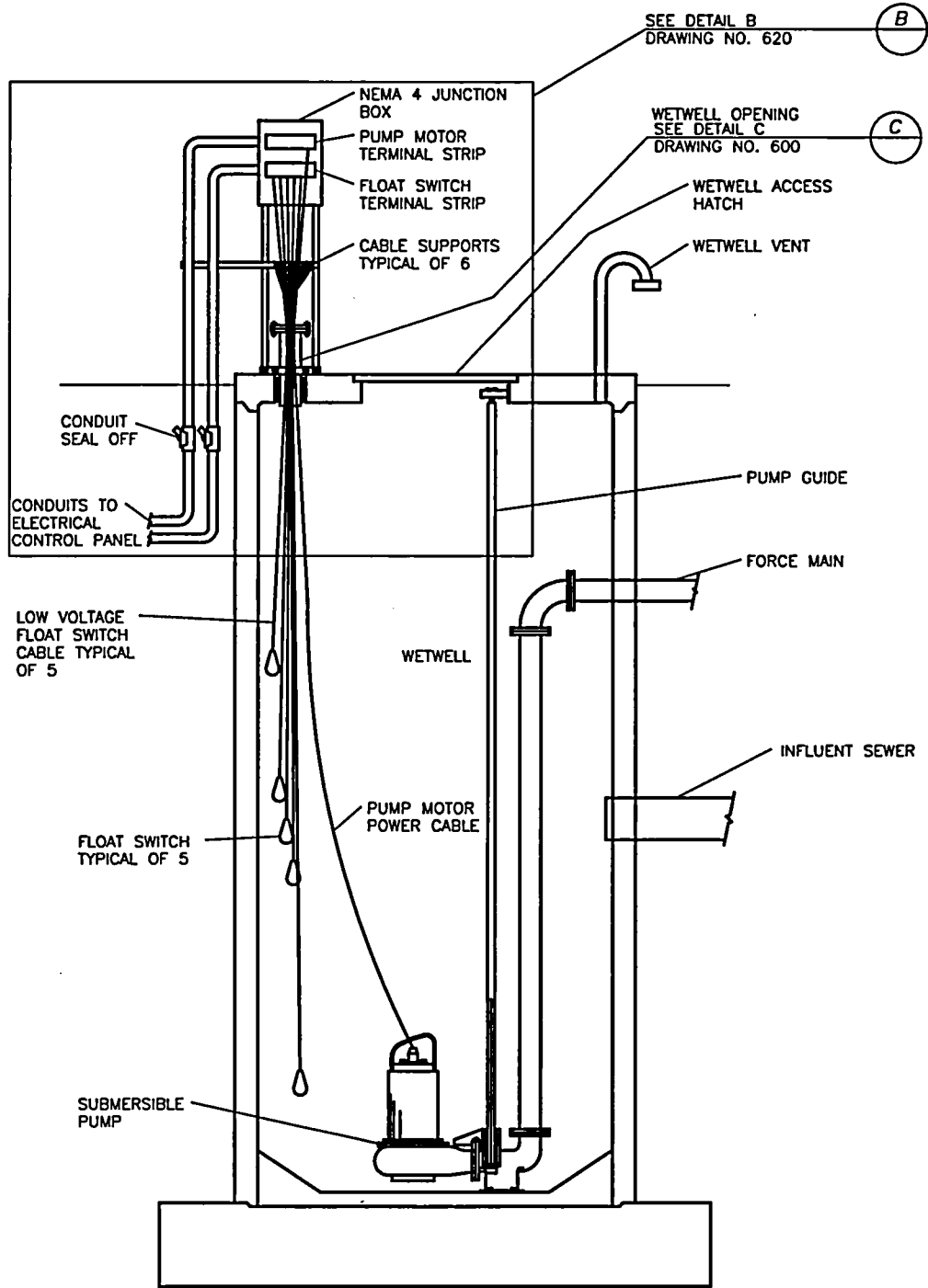
NTS

FLOAT SWITCH PLAN AND DETAIL C

DRAWING NO. 600

REVISED 02-03





PUMPSTATION SECTION A (A)

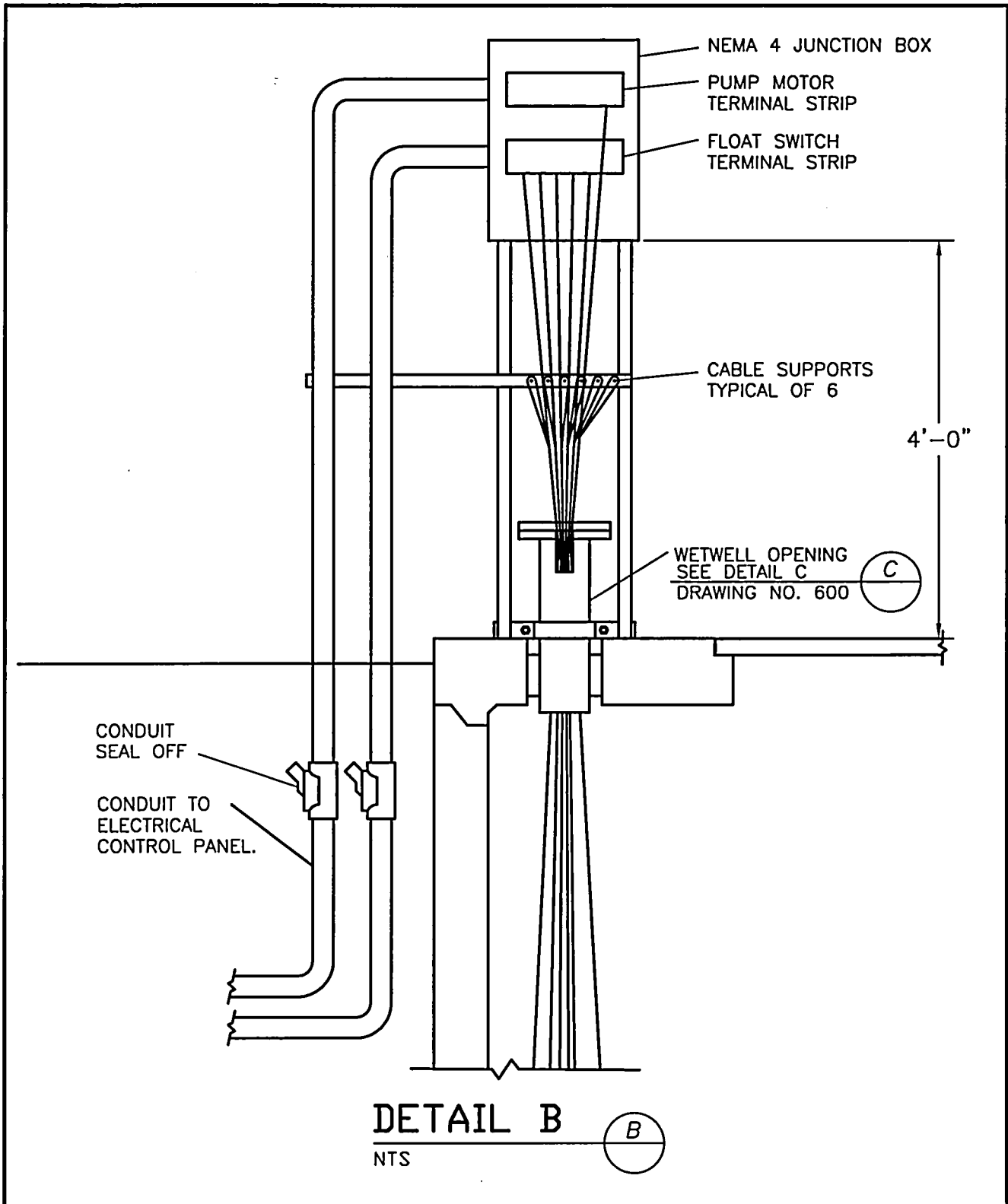
NTS

FLOAT SWITCH SECTION A

DRAWING NO. 610

REVISED 02-03





FLOAT SWITCH
DETAIL B

DRAWING NO. 620

REVISED 02-03

Sample Design Data Table	
Basin Area	XX Acres
Equivalent Dwelling Units (EDU) Per Acre	XX EDU/AC
Persons Per EDU	XX
Population Equivalent	XX
Average Per Capita Flow	XX GPM
Infiltration And Inflow	XX GPM
Average Daily Flow (ADF)	XX GPM
Peak Hourly Flow	XX GPM
Pump Type	Description
Pump Horsepower	XX HP
Capacity Per Pump	XX GPM
Maximum Pump Starts Per Hour	XX
Wet Well Volume	XX GAL
Level Control Type	Ultrasonic or Float
Standby Power Generator	XX KW
Fuel Tank Capacity	XX GAL
Force Main Length	XX FT
Force Main Velocity At ADF	XX FPS
Average Detention Time At Average Daily Flow	XX MIN

SAMPLE DESIGN DATA TABLE

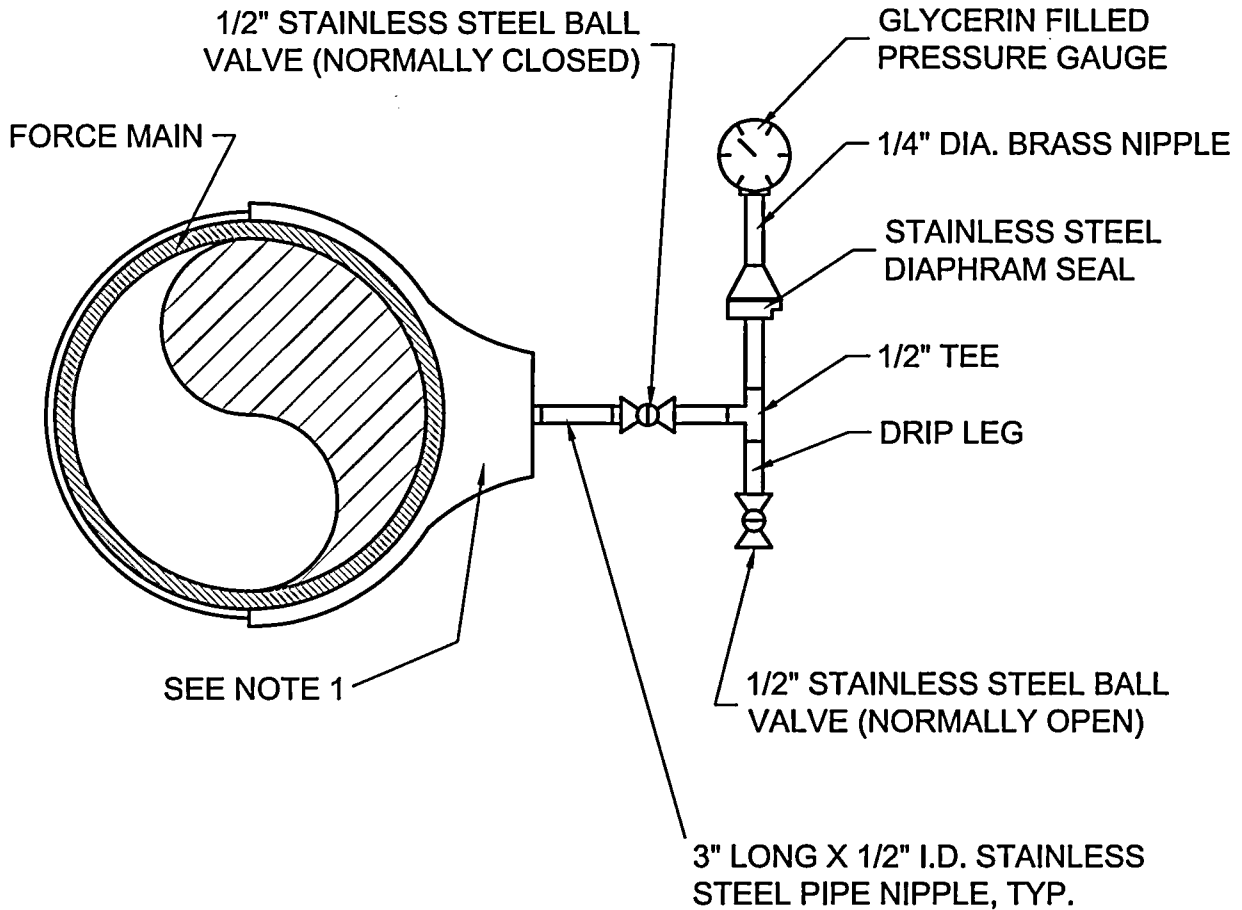
DRAWING NO. 630

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NOTES:

- 1) INSTALL GAUGES AS SHOWN ON 1/2" DOUBLE STRAP PIPE SADDLE.
- 2) ALL THREADED STAINLESS STEEL SCHEDULE 80.



FORCE MAIN PRESSURE GAUGE DETAIL

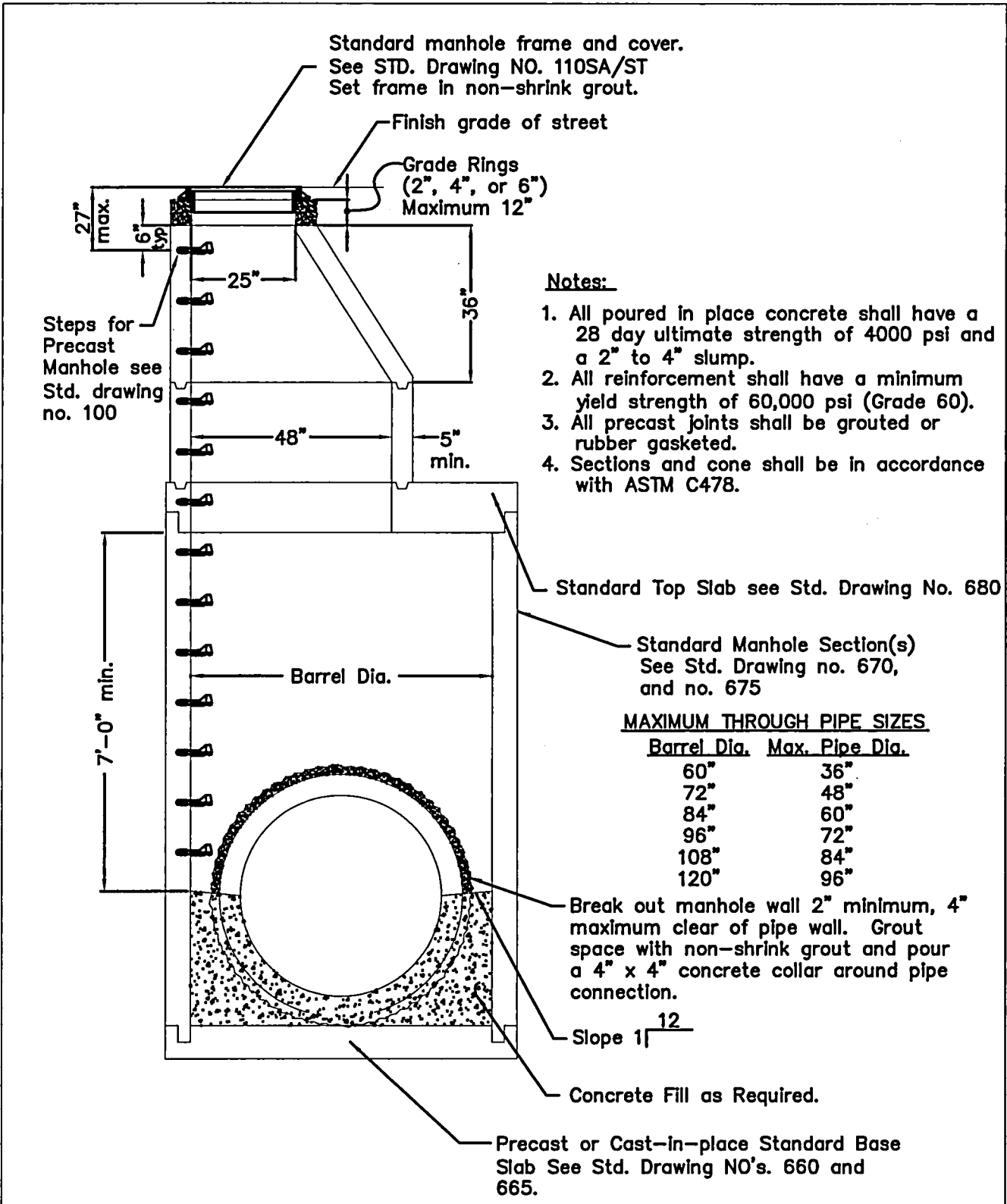
N.T.S.

**FORCE MAIN
PRESSURE GAUGE**

DRAWING NO. 640

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Notes:

1. All poured in place concrete shall have a 28 day ultimate strength of 4000 psi and a 2" to 4" slump.
2. All reinforcement shall have a minimum yield strength of 60,000 psi (Grade 60).
3. All precast joints shall be grouted or rubber gasketed.
4. Sections and cone shall be in accordance with ASTM C478.

MAXIMUM THROUGH PIPE SIZES

<u>Barrel Dia.</u>	<u>Max. Pipe Dia.</u>
60"	36"
72"	48"
84"	60"
96"	72"
108"	84"
120"	96"

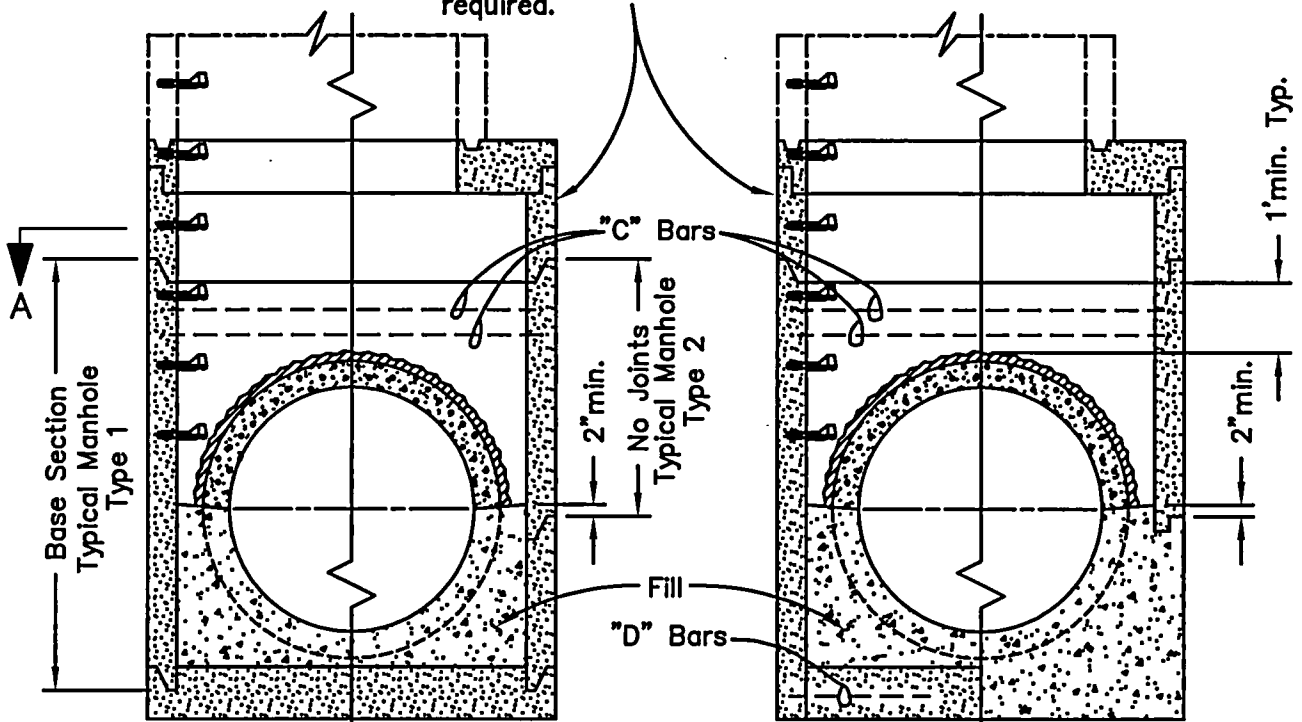
LARGE PRECAST CONCRETE MANHOLE

DRAWING NO. 650

REVISED 02-03

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Additional sections as required.
No special vertical reinforcement required.



Precast Base Type 1
Manhole Type 1

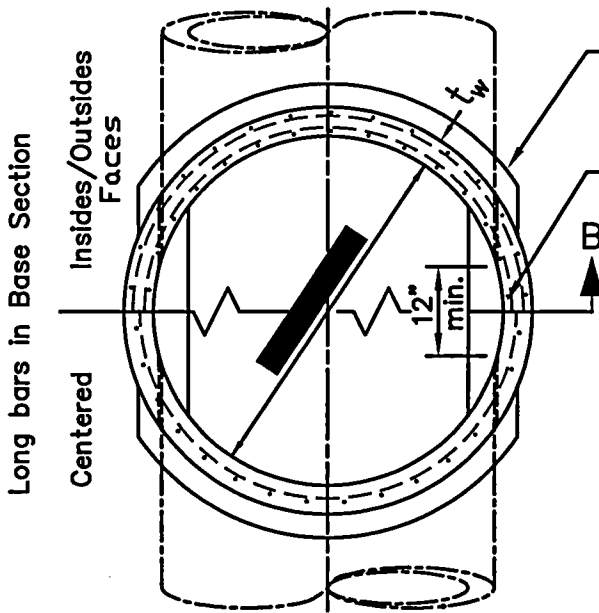
Precast Base Type 2
Manhole Type 2

Precast Base Type 3
Manhole Type 1

Cast-in-Place Base
Manhole Type 2

Section - B

Section - B'



Section - A

4"x4" or 6"x6" Concrete Collar
around pipe connections.

Minimum between breakouts for pipes.

NOTES: (Manhole Bases & Base Sections)

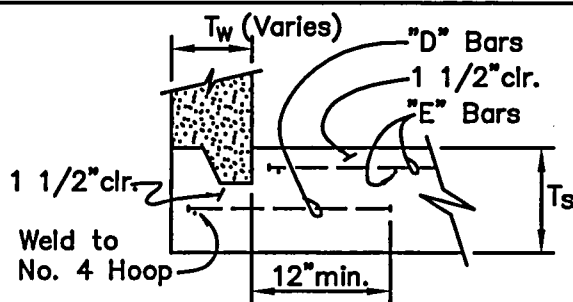
1. Manhole Type 1 is continuous from bottom slab to 12" above pipe breakout.
2. Manhole Types 1 & 2 may have either precast or cast-in-place base.
3. Manhole sections shall be manufactured in accordance to the requirements shown on Std. drawing NO. 660 and 670.
4. Manhole Type 2 shall have no joints between 1' above pipe breakout opening and 2" below pipe spring line.
5. Manhole sections shall be manufactured in accordance with ASTM C76 or C478 except longitudinal (vert.) steel shall meet or exceed that shown on Std. drawing NO. 670.

LARGE PRECAST CONCRETE MANHOLE - BASES

Drawing NO. 655

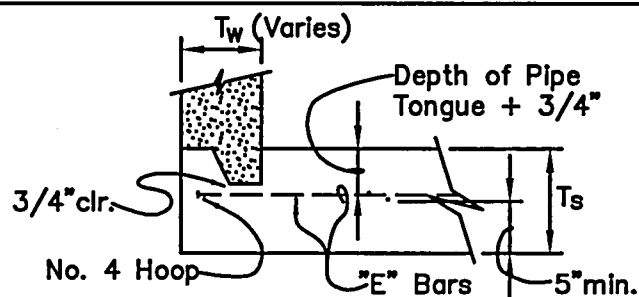
REVISED 02-03





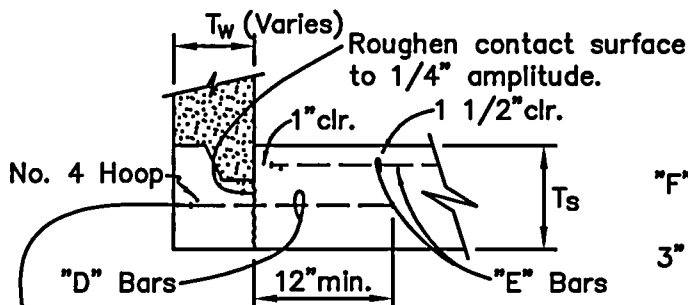
Note: Wall to slab joint shall be grouted when slab is cast separately.

PRECAST BASE SLAB TYPE 1**



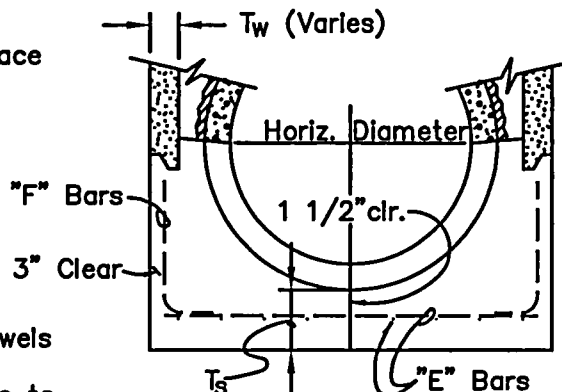
Note: Grout not required for slab cast in contact with manhole section.

PRECAST BASE SLAB TYPE 2**



Note: Expose hoop as required to weld dowels to hoop. Remove only enough concrete to accomplish weld. Patch before casting base to ensure no voids are present.

PRECAST BASE SLAB TYPE 3



CAST-IN-PLACE BASE (OR PRECAST BASE TYPE 4)

SIZE		60"		72"		84"		96"	
Type	Depth*	0'-15'	15'-30'	0'-15'	15'-30'	0'-15'	15'-30'	0'-15'	15'-30'
1	Ts	8.0"	9.0"	8.0"	9.0"	9.0"	10.0"	9.0"	11.0"
	D Bars	#3 @ 12"	#3 @ 12"	#3 @ 12"	#4 @ 10"	#3 @ 10"	#4 @ 11"	#3 @ 9"	#4 @ 11"
	E Bars	#4 @ 12"	#4 @ 9"	#4 @ 9"	#4 @ 6"	#4 @ 8"	#5 @ 9"	#4 @ 7"	#5 @ 8"
2	Ts	11.0"	12.0"	11.0"	12.0"	12.0"	13.0"	12.0"	14.0"
	E Bars	#4 @ 12"	#4 @ 8"	#4 @ 9"	#5 @ 8"	#4 @ 7"	#5 @ 7"	#4 @ 5"	#5 @ 6"
3	Ts	7.0"	9.0"	7.0"	9.0"	8.0"	10.0"	9.0"	11.0"
	D Bars	#3 @ 12"	#3 @ 12"	#3 @ 12"	#4 @ 10"	#3 @ 10"	#4 @ 11"	#3 @ 9"	#4 @ 11"
	E Bars	#4 @ 12"	#4 @ 9"	#4 @ 9"	#4 @ 6"	#4 @ 8"	#5 @ 9"	#4 @ 7"	#5 @ 8"
4	Ts	7.0"	9.0"	7.0"	9.0"	8.0"	10.0"	9.0"	11.0"
	E Bars	#4 @ 12"	#4 @ 9"	#4 @ 9"	#4 @ 6"	#4 @ 8"	#5 @ 9"	#4 @ 7"	#5 @ 8"
	F Bars	#4 @ 12"	#4 @ 9"	#4 @ 9"	#4 @ 6"	#4 @ 8"	#5 @ 9"	#4 @ 7"	#5 @ 8"

*Invert to Street Grade
Concrete: $f_c = 4,000$ psi
Steel: $f_y = \text{Grade 60}$

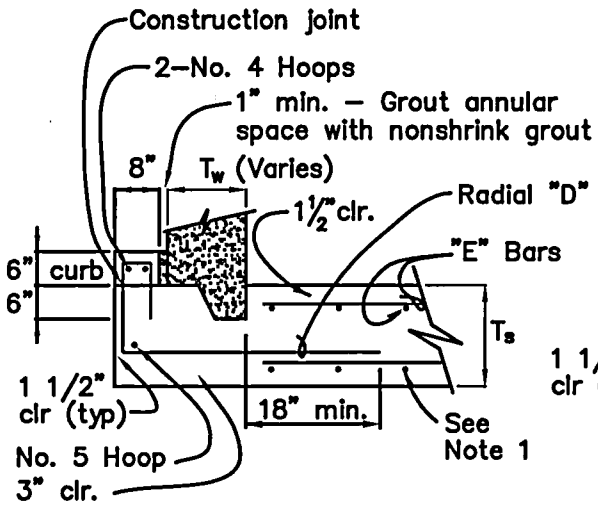
**Fabricator required to cast lifting loops in base slab for handling Type 1 & 2 bases.

DOT 11/26/1999

LARGE PRECAST CONCRETE MANHOLE – TYPES
DRAWING NO.660

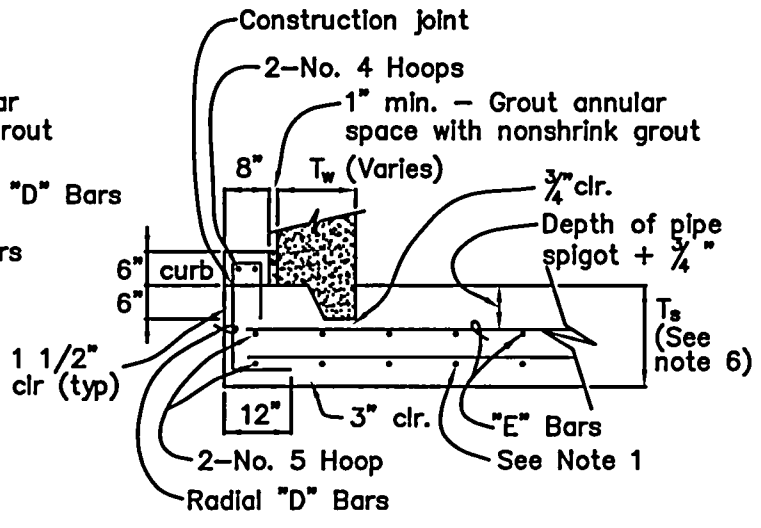
REVISED 02-03

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PRECAST BASE SLAB TYPE 5

1. Add bottom mat of No. 3 bars each way at same spacing as top mat.
2. Wall to slab joint shall be field grouted.
3. Curb is continuous all around base slab.
4. If curb is not cast monolithic with base slab, provide construction joint as shown.



PRECAST OR CAST-IN-PLACE BASE SLAB TYPE 6

1. Add bottom mat of No. 3 bars each way at same spacing as top mat.
2. Wall to slab joint shall be field grouted. Grout is not required for slab cast in contact with manhole section.
3. Curb is continuous all around base slab.
4. If curb is not cast monolithic with base slab, provide construction joint as shown.
5. Base slab Type 6 may be precast or cast-in-place concrete.
6. T_s for base slab Type 6 assumes a 6 1/4" spigot depth. Adjust T_s for actual spigot depth.
7. Curb may be cast in place against riser pipe without grouting.

SIZE		108"		120"	
Type	Depth*	0'-15'	15'-30'	0'-15'	15'-30'
5	T _s	10"	12"	10"	12"
	"D" Bars	No.4 @ 12"	No.5 @ 12"	No.4 @ 12"	No.5 @ 12"
	"E" Bars	No.5 @ 12"	No.5 @ 12"	No.5 @ 12"	No.6 @ 12"
6	T _s	15.5"	17.5"	15.5"	17.5"
	"D" Bars	No.4 @ 12"	No.5 @ 12"	No.4 @ 12"	No.5 @ 12"
	"E" Bars	No.5 @ 12"	No.5 @ 12"	No.5 @ 12"	No.6 @ 12"


*Invert to Street Grade
 Concrete: f_c = 4,000 psi
 Steel: Grade 60

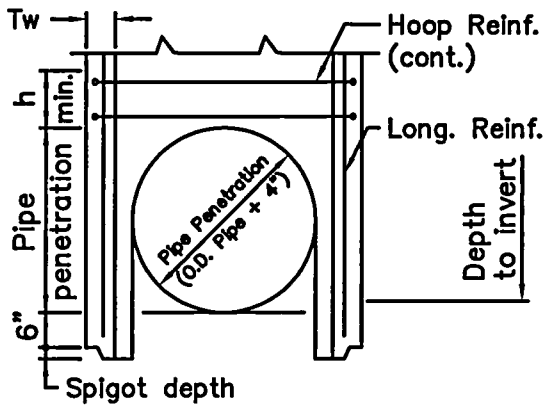
LARGE PRECAST CONCRETE MANHOLE BASE SLABS

DRAWING NO. 665

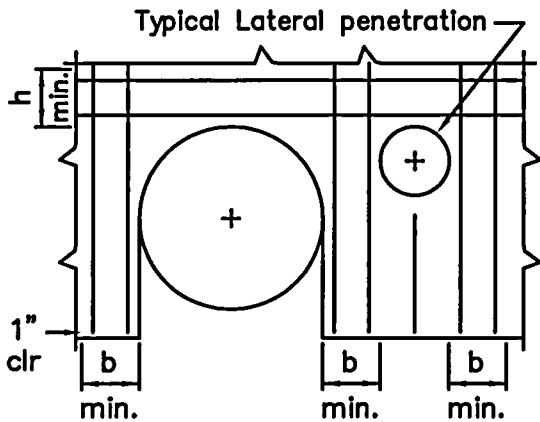
REVISED 02-03



60"∅ Manhole Section			NOTE: MAX. LONG. BAR SPACING IS 12" C.-C.								
	INVERT TO STREET GRADE	T _w = 5.0"			T _w = 6.0"			T _w = 6.75"			
		OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	
TYPE 1	0 Ft to 15 Ft	0.16	0.15	0.24	0.16	0.09	0.20	0.13	0.08	0.17	
	15 Ft to 30 Ft	0.32	0.18	0.53	0.25	0.19	0.42	0.22	0.16	0.36	
TYPE 2	0 Ft to 15 Ft	0.17	0.15	0.28	0.19	0.09	0.22	0.16	0.08	0.20	
	15 Ft to 30 Ft	0.37	0.18	0.63	0.28	0.19	0.48	0.24	0.16	0.42	
'C' Bars—1 No. 4 hoop req'd. for less than 2'-0" clr. between blockout and top of section.											
72"∅ Manhole Section			NOTE: MAX. LONG. BAR SPACING IS 12" C.-C.								
	INVERT TO STREET GRADE	T _w = 6.0"			T _w = 7.0"			T _w = 7.75"			
		OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	
TYPE 1	0 Ft to 15 Ft	0.19	0.19	0.26	0.17	0.16	0.22	0.16	0.14	0.20	
	15 Ft to 30 Ft	0.33	0.28	0.58	0.27	0.23	0.48	0.26	0.26	0.42	
TYPE 2	0 Ft to 15 Ft	0.19	0.13	0.28	0.18	0.15	0.23	0.16	0.17	0.28	
	15 Ft to 30 Ft	0.36	0.13	0.65	0.29	0.15	0.52	0.26	0.17	0.46	
'C' Bars— 2 NO. 5 HOOPS 2" CLR. OF TOP OF MH BARREL } 2 NO. 3 HOOPS 2" CLR. OVER PIPE BLOCKOUTS } REQ'D. FOR LESS THAN 2'-0" CLR. BETWEEN BLOCKOUT AND TOP OF SECTION.											
84"∅ Manhole Section			NOTE: MAX. LONG. BAR SPACING IS 12" C.-C.								
	INVERT TO STREET GRADE	T _w = 7.0"			T _w = 8.0"			T _w = 8.75"			
		OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	
TYPE 1	0 Ft to 15 Ft	0.20	0.13	0.26	0.17	0.12	0.22	0.15	0.10	0.20	
	15 Ft to 30 Ft	0.33	0.23	0.59	0.28	0.26	0.50	0.30	0.23	0.45	
TYPE 2	0 Ft to 15 Ft	0.23	0.15	0.33	0.21	0.17	0.28	0.19	0.19	0.25	
	15 Ft to 30 Ft	0.36	0.15	0.65	0.30	0.17	0.55	0.30	0.19	0.49	
'C' Bars— 2 NO. 5 HOOPS 2" CLR. OF TOP OF MH BARREL } 2 NO. 3 HOOPS 2" CLR. OVER PIPE BLOCKOUTS } REQ'D. FOR LESS THAN 2'-0" CLR. BETWEEN BLOCKOUT AND TOP OF SECTION.											
96"∅ Manhole Section			NOTE: MAX. LONG. BAR SPACING IS 12" C.-C.								
	INVERT TO STREET GRADE	T _w = 8.0"			T _w = 9.0"			T _w = 9.75"			
		OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	OUTSIDE	INSIDE	ON CTR.	
TYPE 1	0 Ft to 15 Ft	0.25	0.18	0.33	0.21	0.16	0.29	0.21	0.14	0.27	
	15 Ft to 30 Ft	0.41	0.26	0.77	0.35	0.30	0.66	0.37	0.27	0.59	
TYPE 2	0 Ft to 15 Ft	0.26	0.17	0.34	0.22	0.19	0.30	0.20	0.21	0.28	
	15 Ft to 30 Ft	0.43	0.17	0.82	0.37	0.19	0.70	0.34	0.21	0.63	
'C' Bars— 2 NO. 5 HOOPS 2" CLR. OF TOP OF MH BARREL } 2 NO. 3 HOOPS 2" CLR. OVER PIPE BLOCKOUTS } REQ'D. FOR LESS THAN 2'-0" CLR. BETWEEN BLOCKOUT AND TOP OF SECTION. DOT 12/08/1999											
PROVIDE MIN. LONGITUD. REINF. AS SHOWN, 1" CLR. OF INSIDE AND OUTSIDE FACES, OR AT CENTER OF WALL					AREAS ARE IN ² /FT OF CIRCUMFERENCE AND MAY BE WELDED WIRE FABRIC, BARS OR A COMBINATION OF BOTH.						
LARGE PRECAST CONCRETE MANHOLE – LONG. BASE SECTION REINF.							 Our commitment is clear.				
DRAWING NO. 670			REVISED 02-03								



For Base Slab see 4-08-3A
**MANHOLE BASE SECTION
 ELEVATION**



For Base Slab see 4-08-3A
**PARTIAL MANHOLE BASE
 SECTION ROLLOUT**

Notes:

1. Manufacture manhole base section and risers above in conformance with ASTM C478 except as noted in specifications and herein. Lap length for hoop reinforcement in band "h" shall be 30 bar diameters and laps shall be staggered.
2. Steel reinforcement in bands "h" and "b" is in addition to that required by ASTM C478 and is shown in square inches per foot of band width. Bar spacing shall not exceed 6".
3. Manhole base sections shall have no joints below top of band "h".
4. Concrete: $f'c = 4,000$ psi
 Reinforcement steel: Grade 60
5. There shall be no penetrations in hoop band "h" above main line pipe penetrations or in longitudinal bands "b" next to both sides of all openings.
6. Additional longitudinal reinforcement area can be reduced 50% outside of "b" bands.
7. Thickness "Tw" is minimum manhole base section wall thickness for a given pipe diameter.
8. Do not backfill until concrete fill over the manhole base has achieved 90% of its compressive strength (4,000 psi). For shape of concrete fill see Std. Drawing NO. 650.
9. Provide 6"x6" concrete collar around pipe penetrations per Std. Drawing NO. 655.

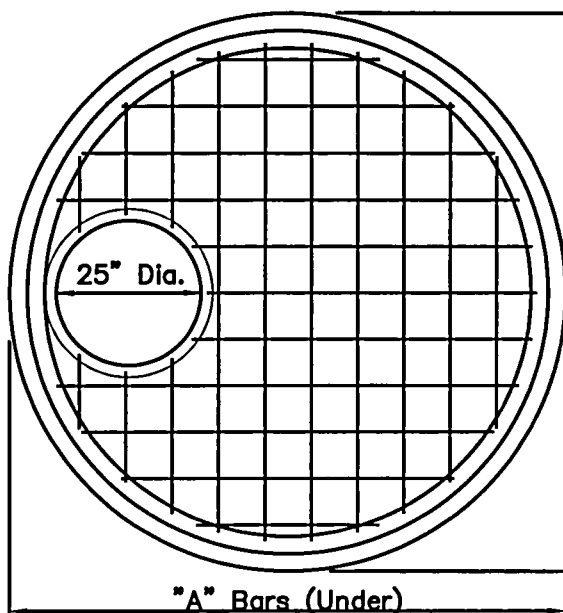
MH Dia. (in)	Thickness Tw min. (in)	Band Width h=b min. (ft)	Depth to Invert max. (ft)	Inside Pipe Dia. (in)	Additional Reinforcement Required			
					Hoop Reinf. (h)		Long. Reinf. (b)	
					Outside Face (in ² /ft)	Inside Face (in ² /ft)	Outside Face (in ² /ft)	Inside Face (in ² /ft)
108	9	1.00	15	48 or less	.381	.381	.260	.260
108	9	1.25	15	54-60	.381	.381	.394	.394
108	10	1.75	15	66-84	.381	.381	.643	.643
108	11	1.00	30	48 or less	.790	.790	.432	.432
108	12	1.25	30	54-60	.790	.790	.576	.576
108	16	1.75	30	66-84	.790	.790	.773	.773
120	10	1.00	15	48 or less	.423	.423	.260	.260
120	10	1.50	15	54-72	.423	.423	.480	.480
120	11	2.00	15	78-96	.423	.423	.713	.713
120	11	1.00	30	48 or less	.880	.880	.432	.432
120	14	1.50	30	54-72	.880	.880	.677	.677
120	17	2.00	30	78-96	.880	.880	.991	.991

**LARGE PRECAST CONCRETE MANHOLE
 Base Section Reinforcement 108" & 120"**

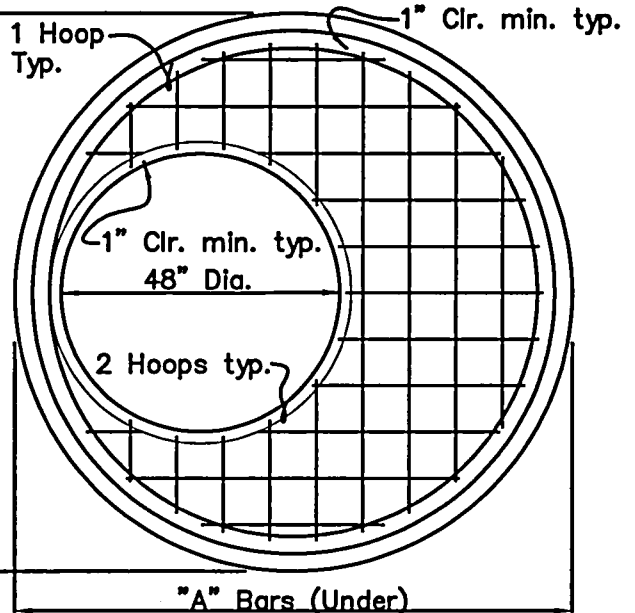
DRAWING NO. 675

REVISED 02-03





"A" Bars (Under)
O.D. Manhole



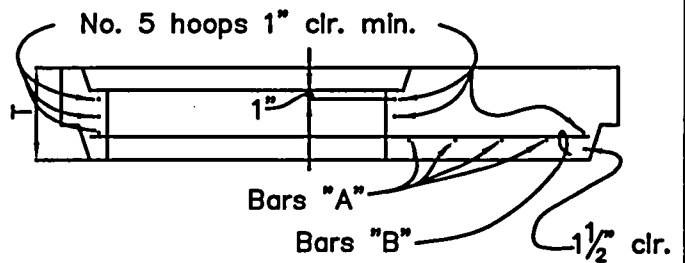
"A" Bars (Under)
O.D. Manhole

NOTES:

TOP SLAB "A"

1. All concrete shall have a 28 day ultimate compressive strength of 4,000 psi.
2. All reinforcement shall have a minimum yield strength of 60,000 psi, (Grade 60).
3. All lap splices shall be 24 bar diameters unless noted otherwise.
4. Add steps as required by Standard Drawing NO. 010

TOP SLAB "B"



TOP SLAB TYPICAL SECTION

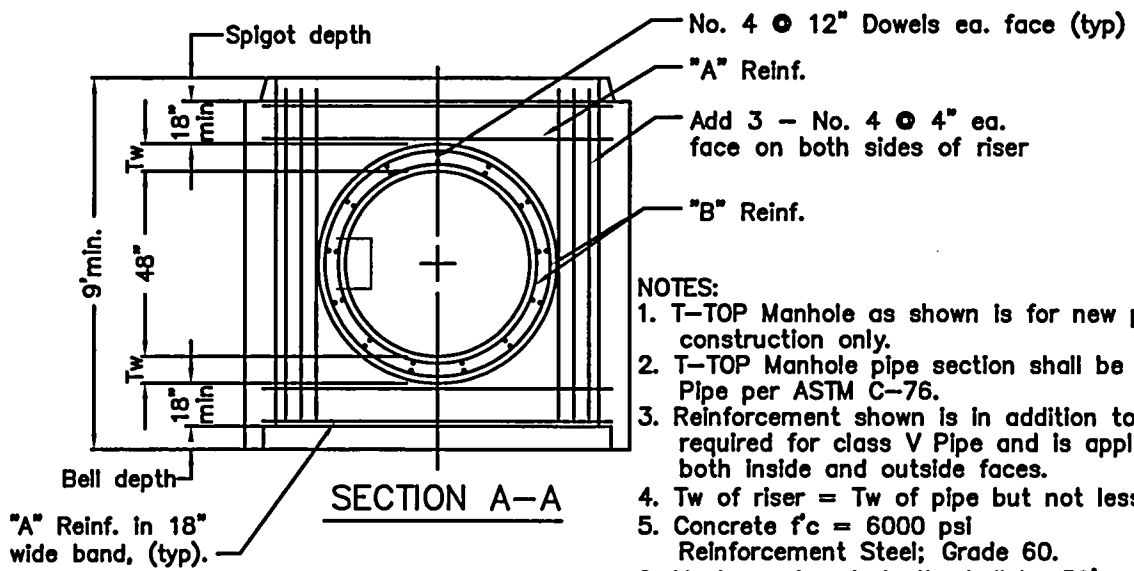
	TOP SLAB "A"			TOP SLAB "B"			TOP SLAB "B"		
	COVER DEPTH								
	6" to 12"			4'-0" to 7'-0"			7'-1" to 22'-0"		
Size	T	"A" Bars	"B" Bars	T	"A" Bars	"B" Bars	T	"A" Bars	"B" Bars
60"	8"	No.5 @ 7½"	No.5 @ 7½"	12"	No.5 @ 9"	No.5 @ 9"	12"	No.5 @ 9"	No.5 @ 9"
72"	10"	No.5 @ 7"	No.5 @ 7"	12"	No.5 @ 9"	No.5 @ 9"	12"	No.5 @ 7"	No.5 @ 7"
84"	11"	No.5 @ 7"	No.5 @ 7"	12"	No.5 @ 6"	No.5 @ 6"	12"	No.6 @ 6"	No.5 @ 7"
96"	12"	No.5 @ 6"	No.5 @ 6"	12"	No.5 @ 6"	No.5 @ 6"	14"	No.6 @ 6"	No.5 @ 6"
108"	N/A	N/A	N/A	12"	No.6 @ 8"	No.6 @ 8"	16"	No.7 @ 9"	No.7 @ 9"
120"	N/A	N/A	N/A	12"	No.6 @ 7"	No.6 @ 7"	16"	No.7 @ 8"	No.7 @ 8"

LARGE PRECAST CONCRETE MANHOLE
TOP SLABS

DRAWING NO. 680

REVISED 02-03





- NOTES:
1. T-TOP Manhole as shown is for new pipeline construction only.
 2. T-TOP Manhole pipe section shall be Class V Pipe per ASTM C-76.
 3. Reinforcement shown is in addition to that required for class V Pipe and is applied in both inside and outside faces.
 4. Tw of riser = Tw of pipe but not less than 6".
 5. Concrete $f'c$ = 6000 psi Reinforcement Steel; Grade 60.
 6. Maximum invert depth shall be 30'.
 7. All pre-cast manhole riser sections shall conform to the requirements of ASTM C-478 and applicable provisions of standard manhole drawing NO. 010

Standard Manhole Frame and Cover. See STD. Drawing NO. 110 SA/ST. Set Frame in Non-shrink Grout.

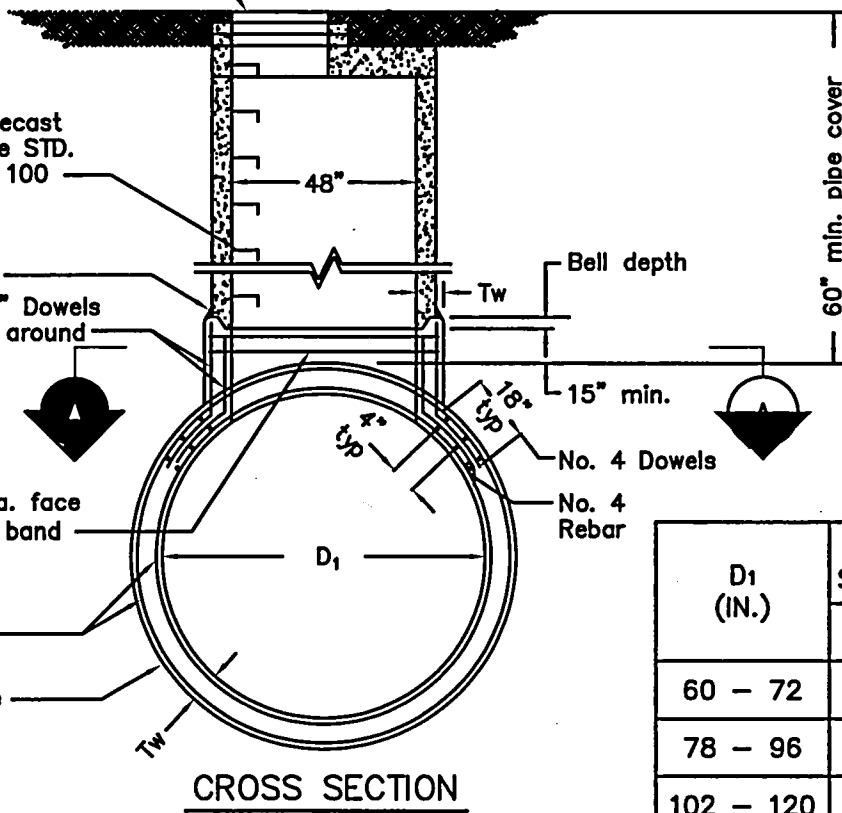
Steps for precast manhole. See STD. Drawing NO. 100

Grout bench No. 4 \odot 12" Dowels ea. face all around

"B" Reinf. ea. face in 15" wide band

"A" Reinf. all around

Class V pipe

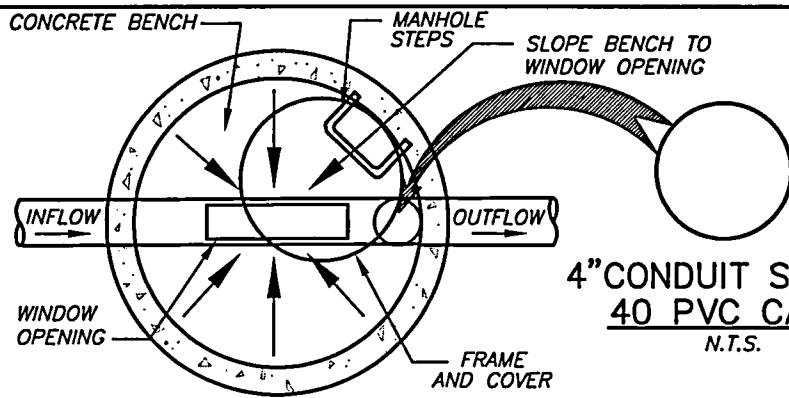


D ₁ (IN.)	ADDITIONAL REINF. SQUARE INCHES (TOTAL)	
	"A"	"B"
60 - 72	.177 EA. FACE	.511 EA. FACE
78 - 96	.224 EA. FACE	.584 EA. FACE
102 - 120	.265 EA. FACE	.658 EA. FACE

T-TOP MANHOLE WITH 48" RISER
DRAWING NO. 685

REVISED 02-03



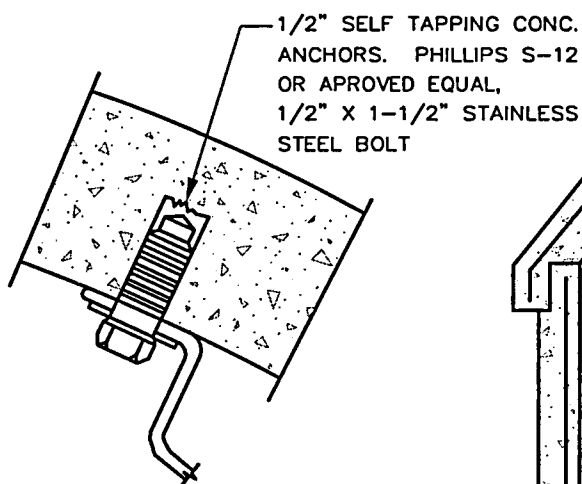


MANHOLE PLAN VIEW
N.T.S.

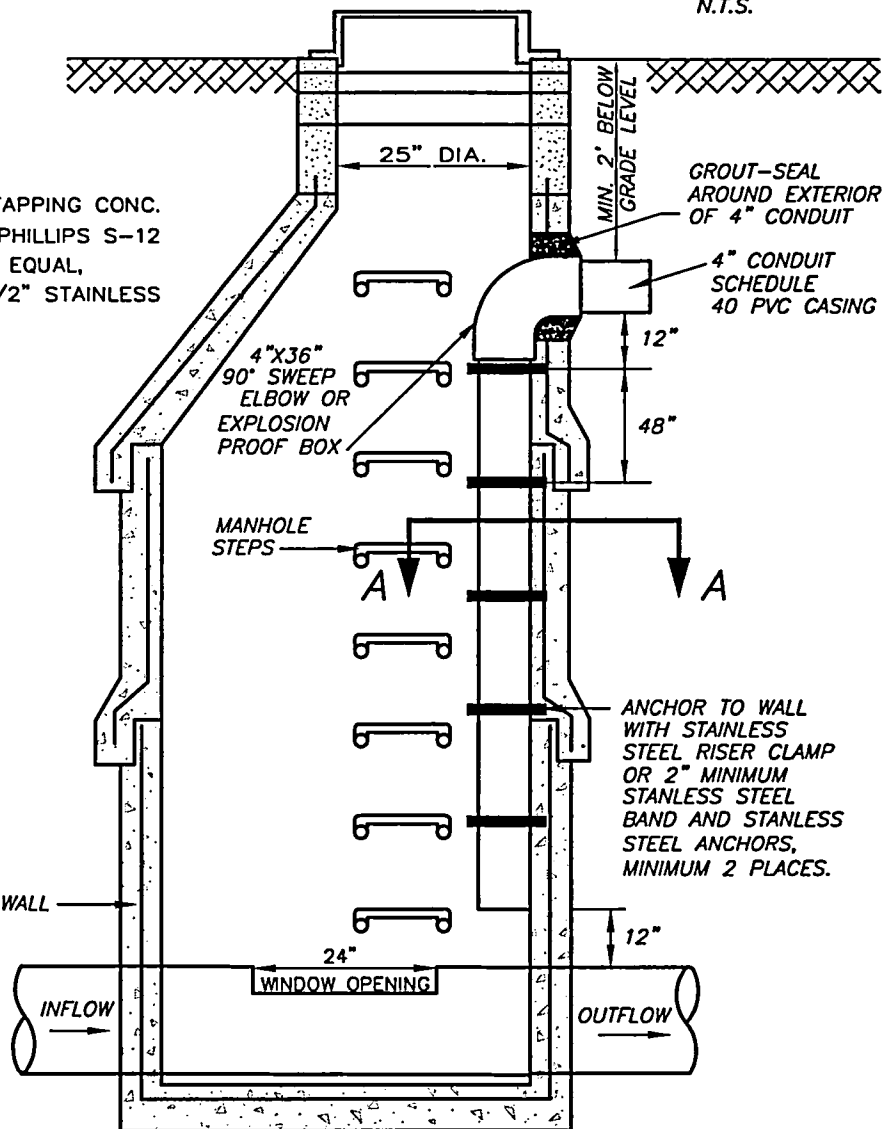
4" CONDUIT SCHEDULE 40 PVC CASING
N.T.S.



CLAMP DETAIL (SECTION A-A)
N.T.S.



PARTITION ATTACHMENT



SECTION
N.T.S.

NOTES:
ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENT OF ASTM C478 AND APPLICABLE PROVISIONS OF STANDARD MANHOLE DRAWING NO. 010. AND NO. 030

SANITARY SEWER PERMANENT FLOW MONITOR DETAILS (MANHOLE CONDUIT INSTALLATION)

DRAWING NO. 695

REVISED 02-03

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CLASS B WITH A/C CAP

CLASS B

CLASS A

4" MINIMUM A/C CAP
SAND SEAL EDGES

6" TEE CUT

MOUND EXCESS NATIVE MATERIAL
OVER TRENCH TO ALLOW FOR
SETTLEMENT

TOP ONE FOOT
OF TRENCH SHALL
BE NATIVE TOPSOIL
FROM EXISTING
TRENCH

ALL TRAVELED ROAD
SHOULDERS AND ALLEY
WAYS SHALL BE COMPACTED
CRUSHED ROCK TO GRADE
OR AS SPECIFIED

95% COMPACTED
3/4"-0" ROCK

90% COMPACTED
NATIVE MATERIAL

UNDISTURBED
EARTH

24" MIN.

3/4"-0" CRUSHED ROCK
PIPE O.D. PLUS 6"

95% COMPACTION

4" CONDUIT, SCHEDULE
40 PVC CASING

4' MIN.

UNDISTURBED
EARTH

CONDUIT TRENCH BACKFILL DETAILS



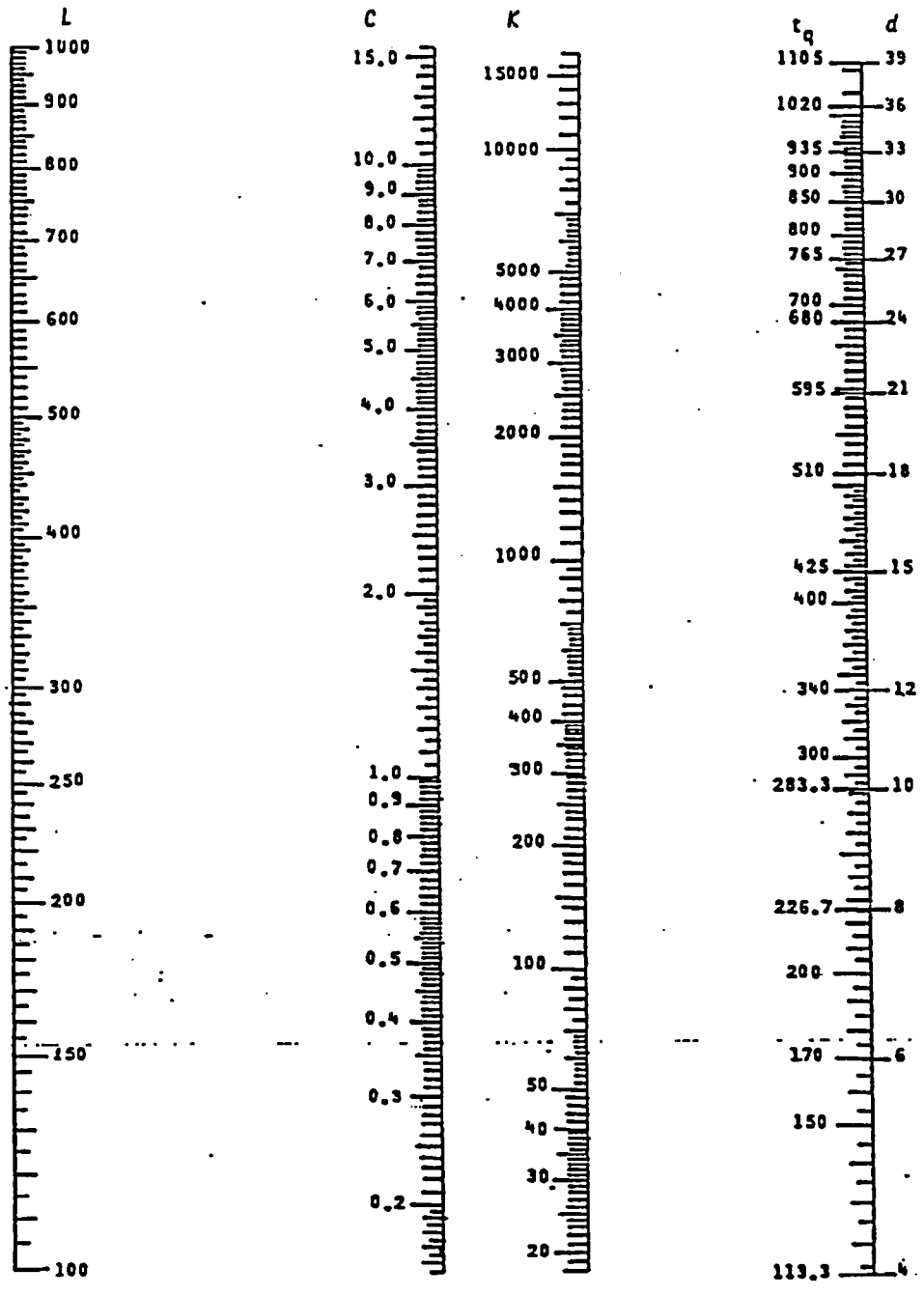


Fig. 1

NOMOGRAPH FOR THE SOLUTION OF $K = .011d^2L$, $C = .003852dL$, $t_q = K - C$

NOMOGRAPH





CLEAN WATER SERVICES OF WASHINGTON COUNTY
 MANHOLE HYDROSTATIC TEST

PROJECT: _____ DATE: _____

CONTRACTOR: _____ PROJ #: _____

TESTING COMPANY: _____ INSPECTOR: _____

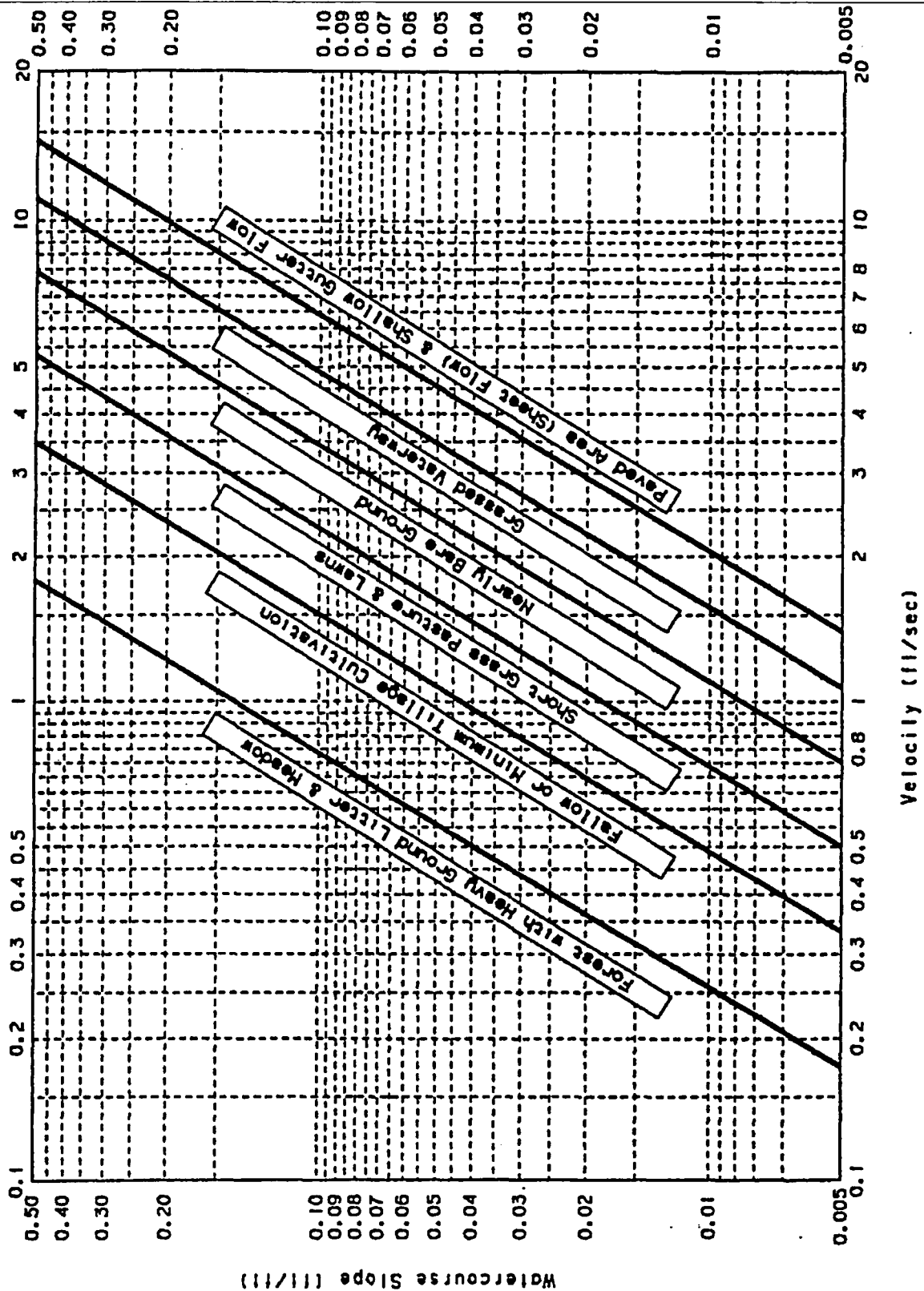
DATE	M.H. #	DEPTH	ALLOWABLE LOSS / HR.	ACTUAL LOSS / HR.	TIME		PASS / FAIL
					START	END	

COMMENTS:

NOTE: ALL MANHOLE HYDROSTATIC TEST WILL BE CONDUCTED IN ACCORDANCE WITH ASTM AND CURRENT CONSTRUCTION STANDARDS RESOLUTION ORDER, ALLOWABLE LEAKAGE SHALL NOT EXCEED 0.2 GALLONS PER HOUR PER FOOT OF HEAD MEASURED FROM INVERT TO TOP OF FRAME.

INSPECTORS SIGNATURE: _____

<p>MANHOLE HYDROSTATIC TEST</p>	
DRAWING NO. 715	REVISED 02-03



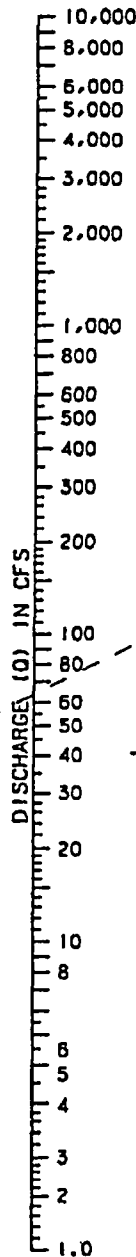
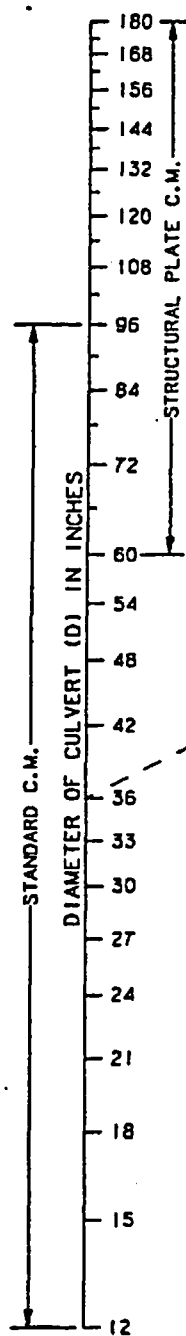
AVERAGE VELOCITIES FOR ESTIMATING TRAVEL TIME FOR OVERLAND FLOWS*

*For use with the Rational Method only; From Soil Conservation Service, Tech. Release No. 55, January 1975

DRAWING NO. 720

REVISED 02-03





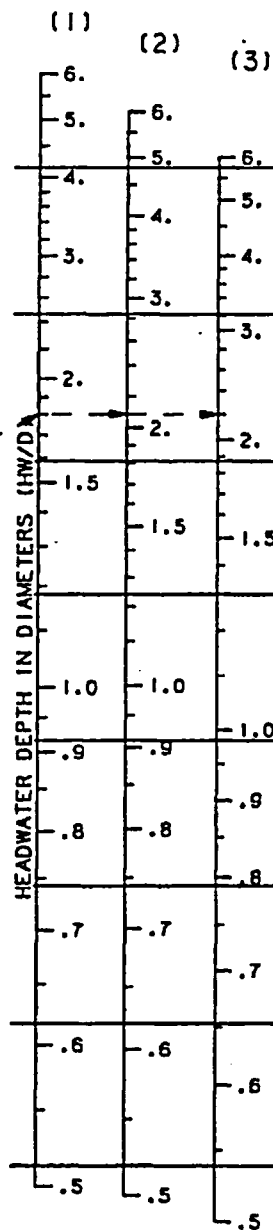
EXAMPLE
 $D=36$ inches (3.0 feet)
 $Q=66$ cfs

	$\frac{HW}{D}$	HW (feet)
(1)	1.8	5.4
(2)	2.1	6.3
(3)	2.2	6.6

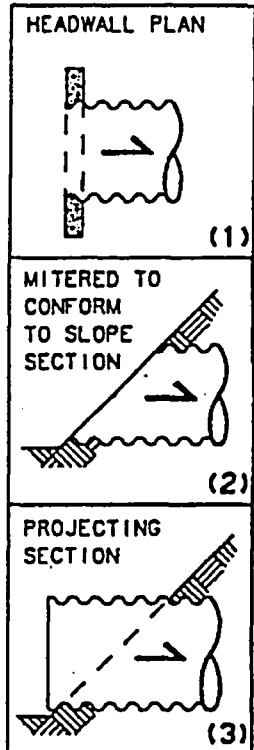
D in feet

$\frac{HW}{D}$ SCALE	ENTRANCE TYPE
(1)	Headwall
(2)	Mitered to conform to slope
(3)	Projecting

To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.



ENTRANCE TYPE

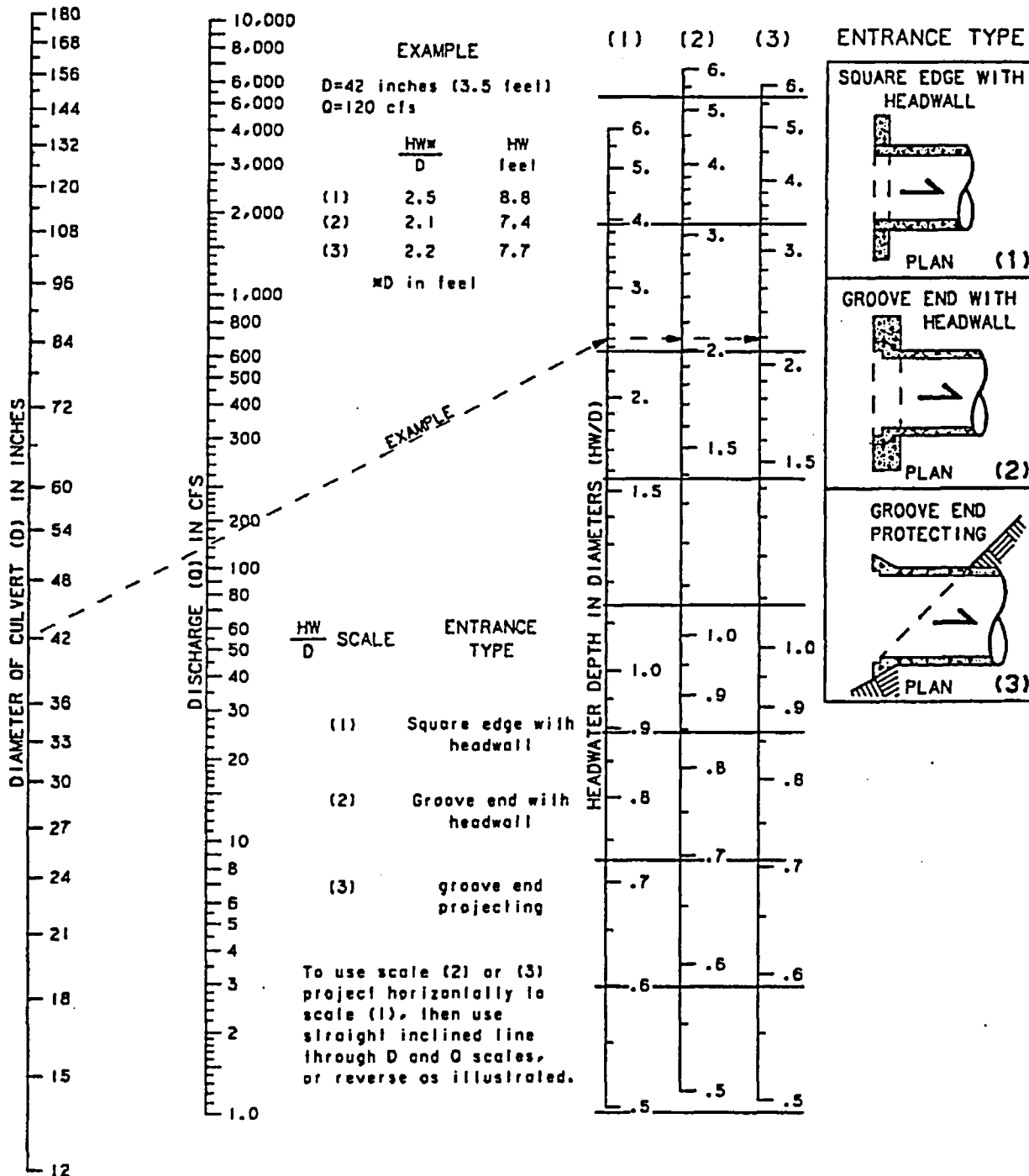


**HEADWATER DEPTH FOR
 CORRUGATED PIPE
 W/INLET CONTROL**

DRAWING NO. 725

REVISED 02-03



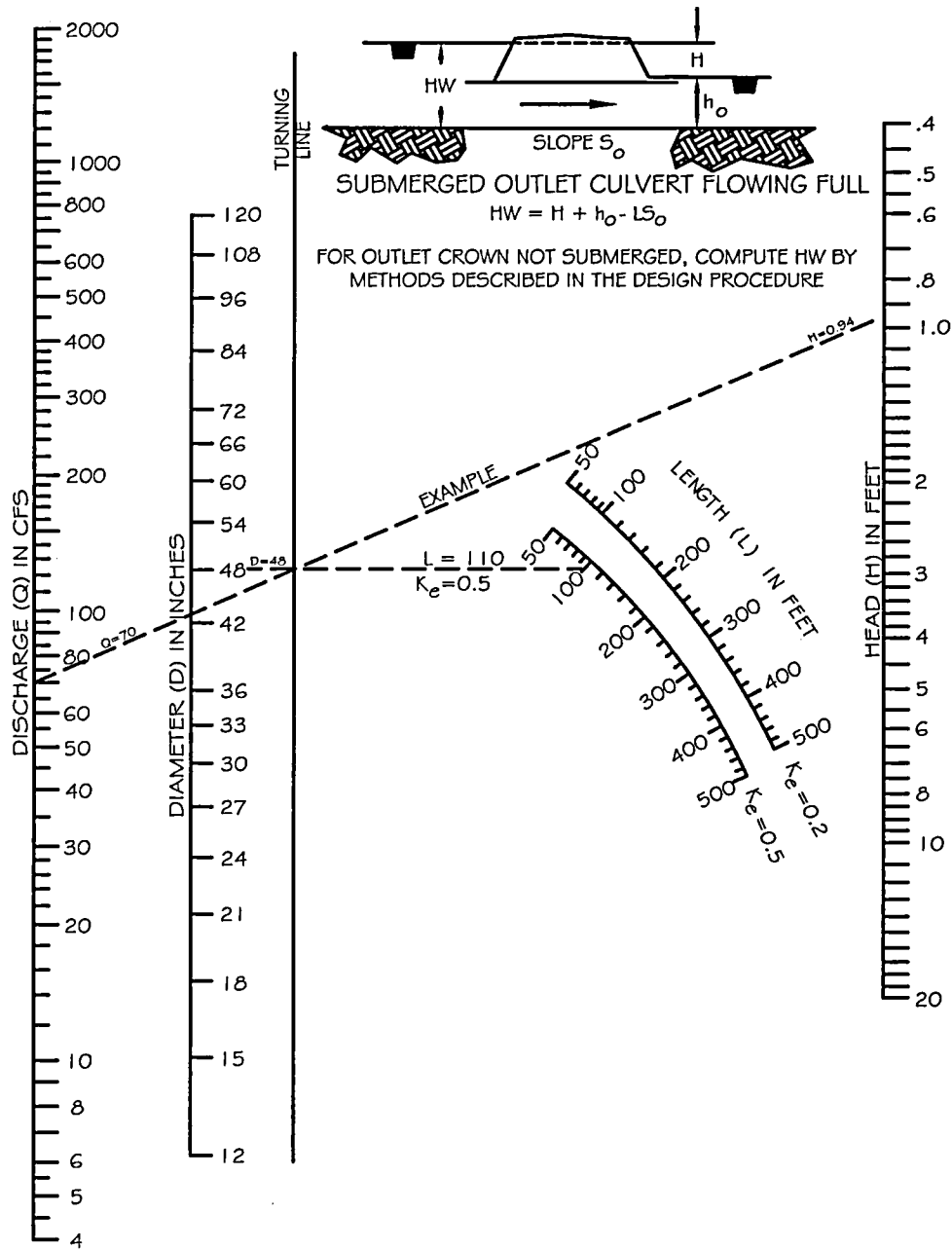


HEADWATER DEPTH FOR SMOOTH INTERIOR PIPE CULVERTS WITH INLET CONTROL

DRAWING NO. 730

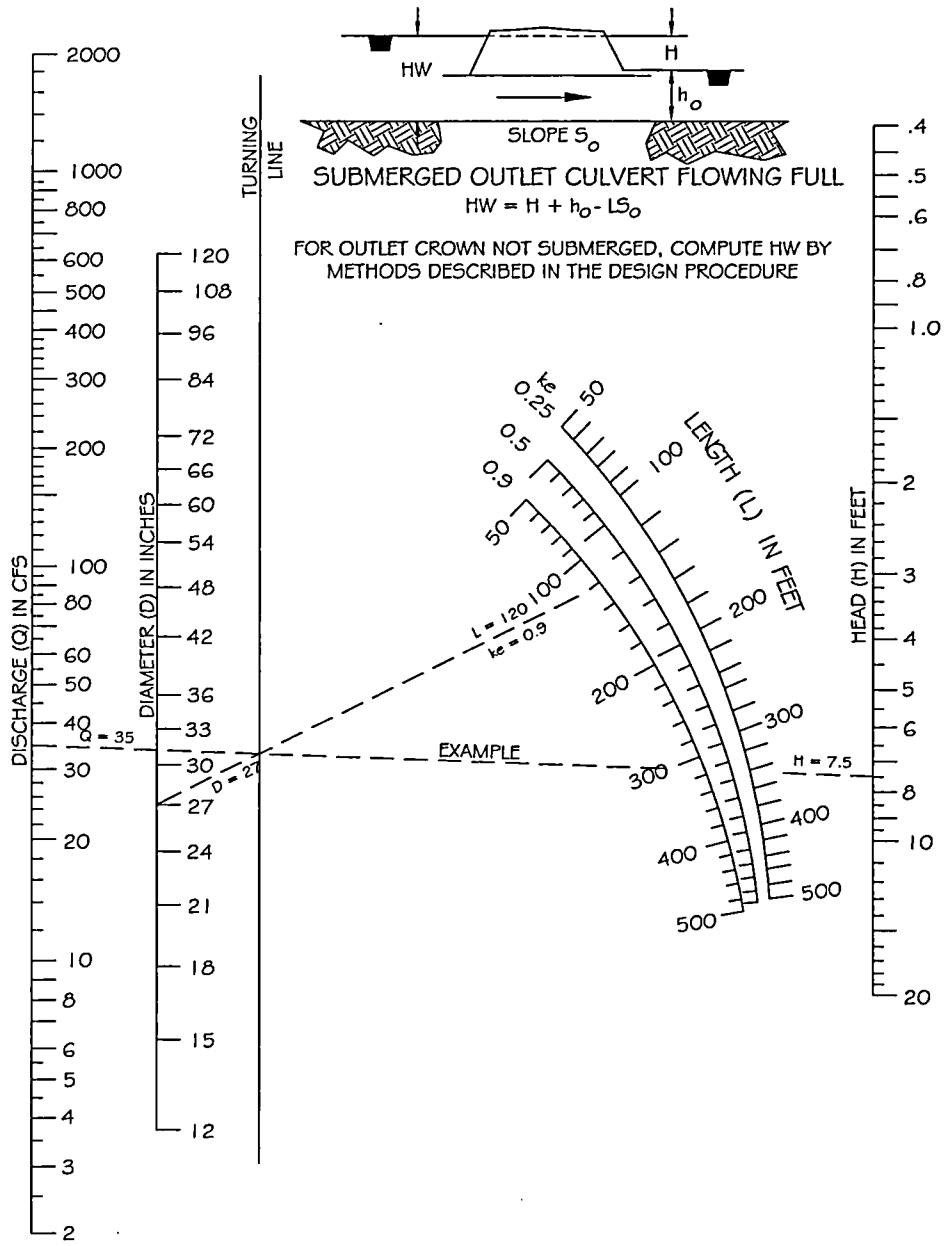
REVISED 02-03

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HEAD FOR CULVERTS
(PIPE W / "N" = 0.012), FLOWING
FULL WITH OUTLET CONTROL

DRAWING NO. 735

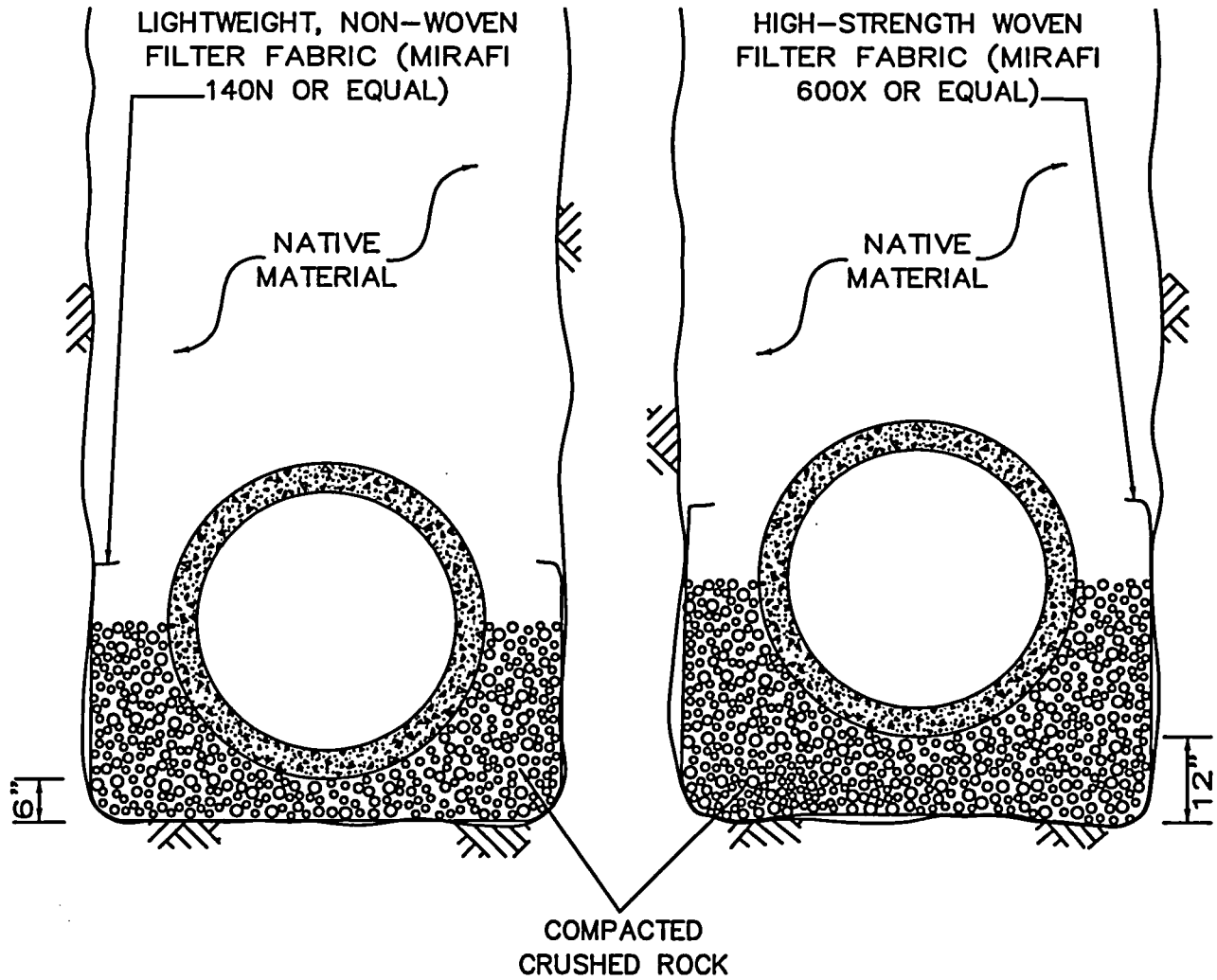


HEAD FOR CULVERTS
 (PIPE W / "N" = 0.024), FLOWING
 FULL WITH OUTLET CONTROL



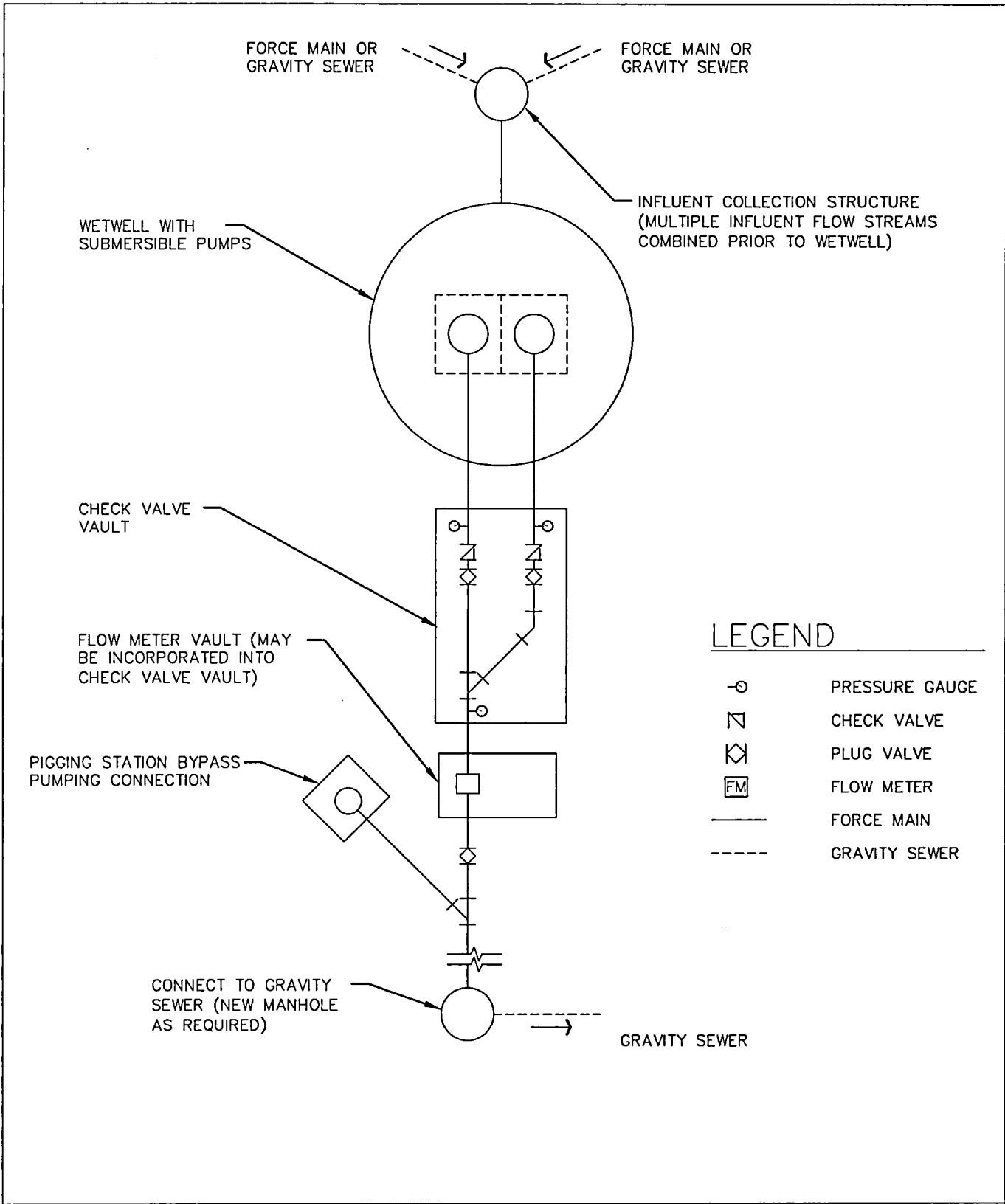
TRENCH "A"

TRENCH "B"



GEOTEXTILE STABILIZATION





CONCEPTUAL SITE SCHEMATIC

DRAWING NO. 1003

REVISED 12-03



DRAWING NO. 1005

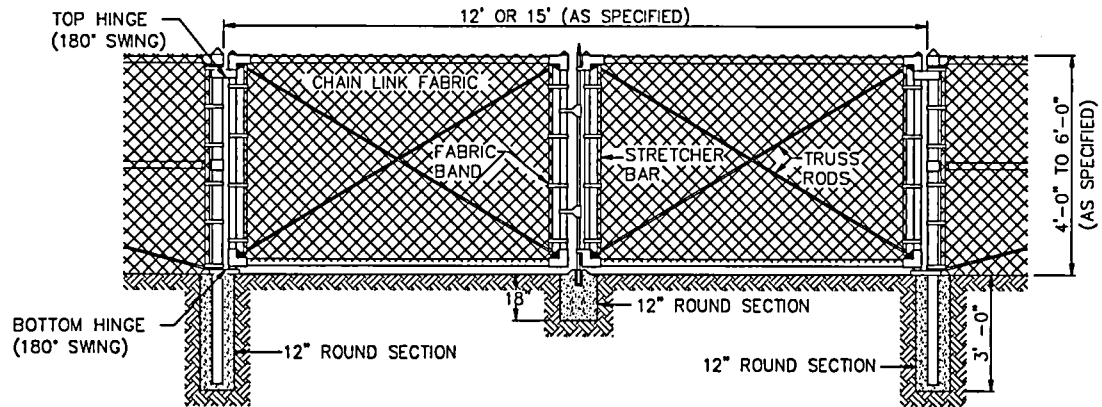
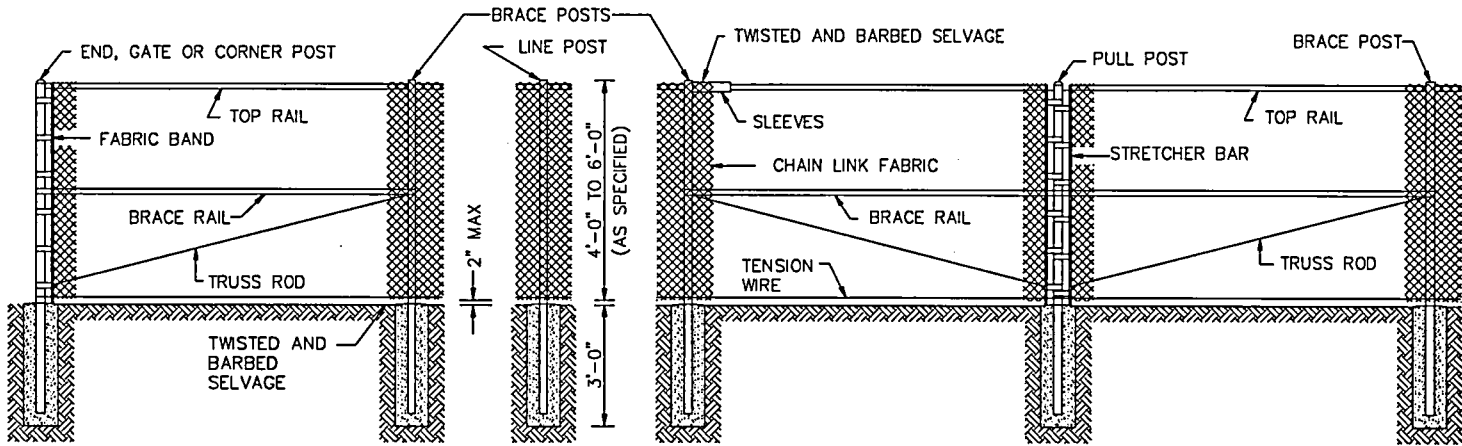
REVISED 12-03

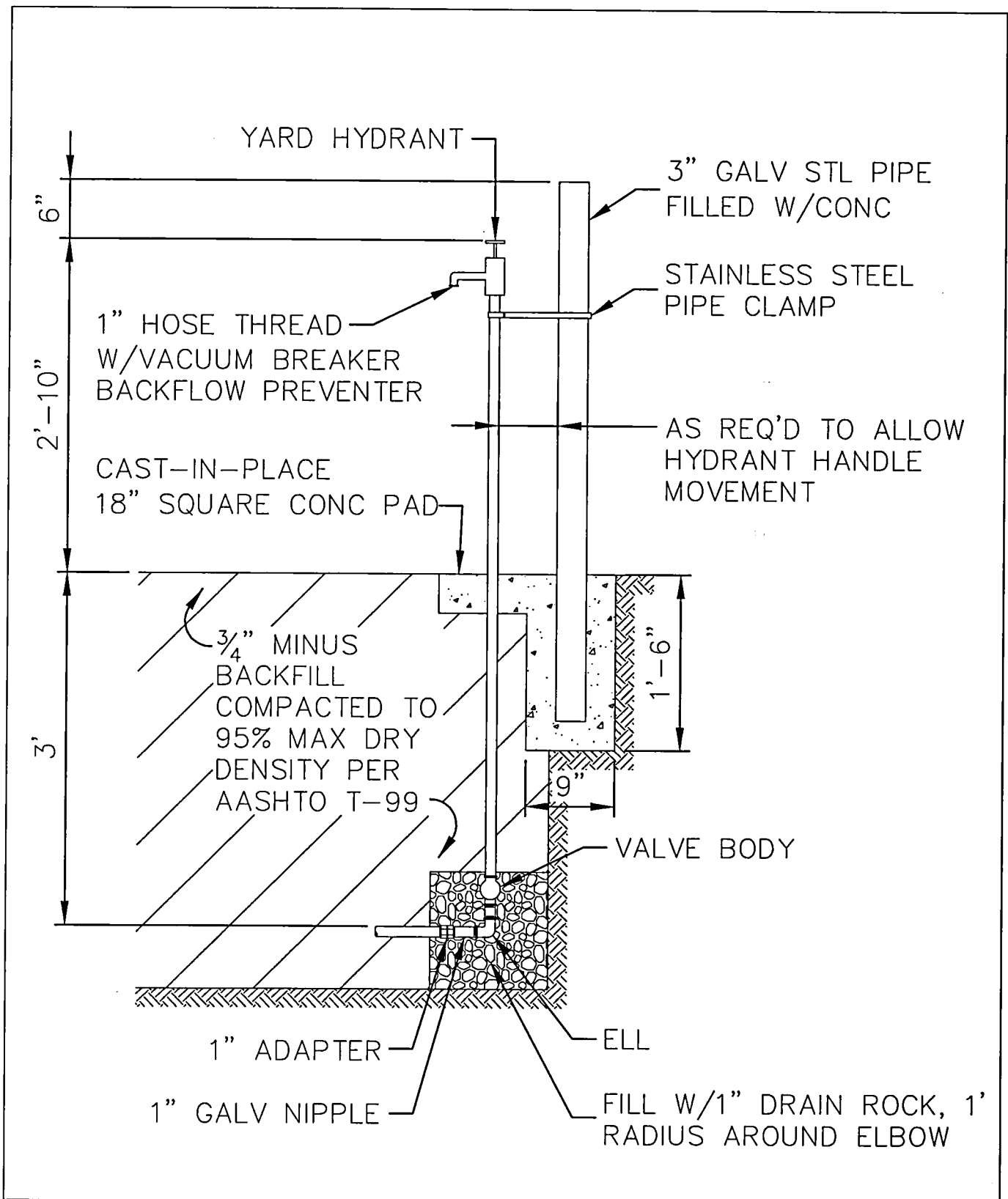
CHAIN LINK FENCE AND GATE

MEMBER	NOMINAL DIA (IN)	MATERIAL	
BRACE RAIL	1.660	GALV TUBULAR STL	
GATE FRAME	2.00	GALV TUBULAR STL	
LINE POSTS	2.375	GALV TUBULAR STL	
END & CORNER POST	2.875	GALV TUBULAR STL	
CHAIN LINK FABRIC		9 GA. W/PVC COATING.	
	GATE OPENING (ft)	NOMINAL DIA (IN)	MATERIAL
GATE POST	12' OR 15'	4	GALV TUBULAR STL

NOTES:

1. ALL FITTINGS, FASTENERS, & AND FABRIC TIES SHALL BE HOT DIP GALV.
2. CONC SHALL BE MIN 2500 PSI @ 28 DAYS.
3. PROVIDE BRACE RAIL BETWEEN END POSTS AND LINE POSTS. LENGTHS AS REQ'D.
4. PROVIDE GATE STOPS AND DROP RECEIVERS SET IN CONCRETE, EACH GATE.
5. PROVIDE EXTENSION ARMS ON LINE, END AND CORNER POSTS & GATE POSTS AS REQ'D.
6. PROVIDE SIGHT OBSCURING SLATS WITH ALL WASTEWATER PUMP STATIONS.
7. CENTER BRACE RAIL NOT REQUIRED WITH FENCE HEIGHT OF 5' OR LESS.



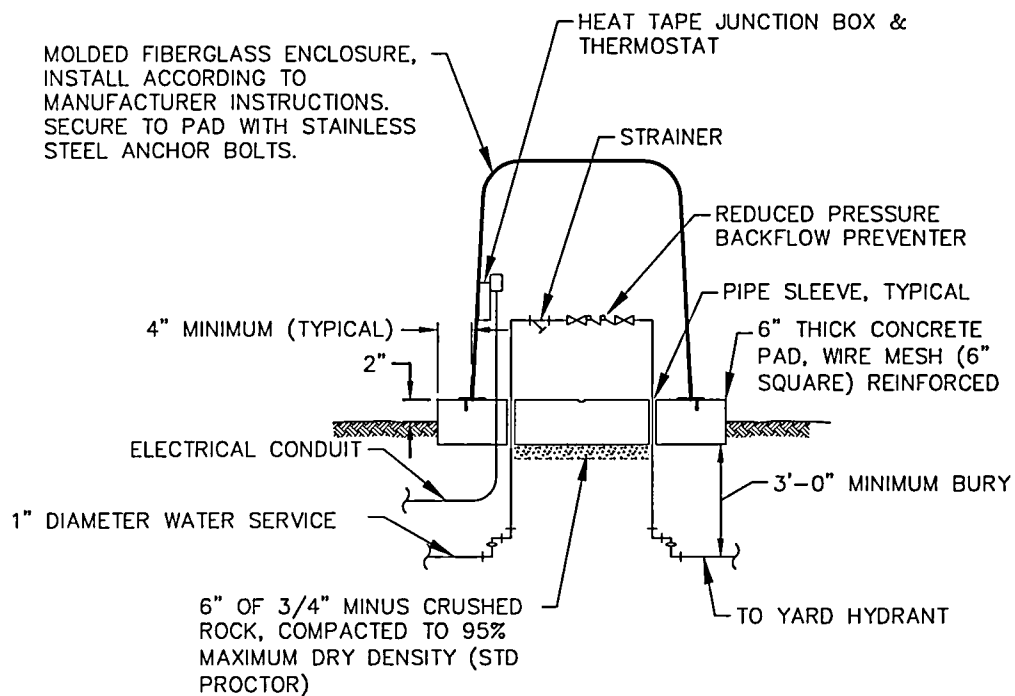


YARD HYDRANT

DRAWING NO. 1009

REVISED 12-03

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NOTE:

1. WRAP EXPOSED WATER PIPE WITH HEAT TAPE AND PVC COATED PIPE INSULATION.

REDUCED PRESSURE BACKFLOW PREVENTER

DRAWING NO. 1011

REVISED 12-03

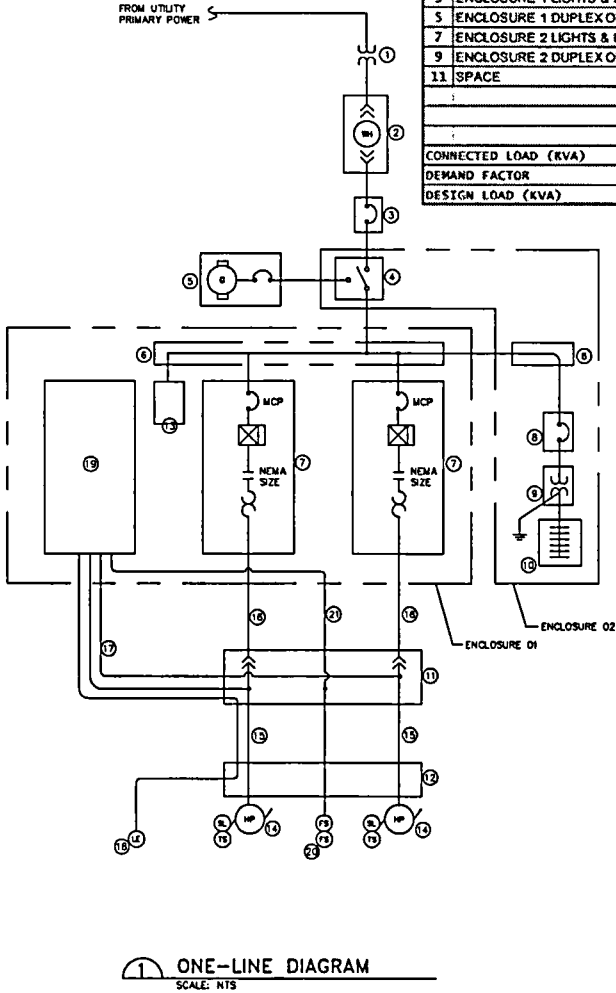
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DRAWING NO. 1071

ONE-LINE DIAGRAM

ELECTRICAL

REVISED 12-03



1 ONE-LINE DIAGRAM
SCALE: NTS

PANELBOARD NO:		LOAD CENTER									
VOLTAGE:	120/240	BUS RATING (A):	100			ENCLOSURE:	NEMA 1				
PHASE:	1	MAIN DC DEVICE:	60/2			MOUNTING:	SURFACE				
WIRE:	3+GND	INTERRUPTING RATING (KA):	10			LOCATION:	ENCLOSURE 1				
200% NEUTRAL:	NO	SERVICE ENTRANCE LABEL:	NO								

CKT NO.	DESCRIPTION	CONNECTED LOAD (VA)				OCP		CONNECTED LOAD (VA)				DESCRIPTION	CKT NO.				
		LTS	REC	MECH	MISC	AMPS	P	AMPS	P	LTS	REC			MECH	MISC		
1	CONTROL POWER				600	20	1 A	20	1					360		WEATHER PROOF DUPLEX	2
3	ENCLOSURE 1 LIGHTS & HEATER	300				20	1 B	20	1				300		AUTO DIALER	4	
5	ENCLOSURE 1 DUPLEX OUTLET		360			20	1 A	20	1					100	FLOW TRANSMITTER	6	
7	ENCLOSURE 2 LIGHTS & HEATER	300				20	1 B	20	1					100	WETWELL LEVEL	8	
9	ENCLOSURE 2 DUPLEX OUTLET		360			20	1 A	20	1					1,000	GENERATOR BATTERY CHARGER	10	
11	SPACE					20	1 B	20	1					1,500	GENERATOR BLOCK HEATER	12	

LOAD SUMMARY							PHASE BALANCE		
	LTS	REC	MECH	MISC	SPARE	TOTAL			
CONNECTED LOAD (KVA)	0.6	1.4	0.0	3.3	---	5.3	240	LINE-TO-LINE VOLTS	PHASE A (KVA)
DEMAND FACTOR	1.25	NEC	1.00	1.00	20%	---	22	CONNECTED AMPS	PHASE B (KVA)
DESIGN LOAD (KVA)	0.8	1.4	0.0	3.3	1.1	6.5	27	DESIGN AMPS	###

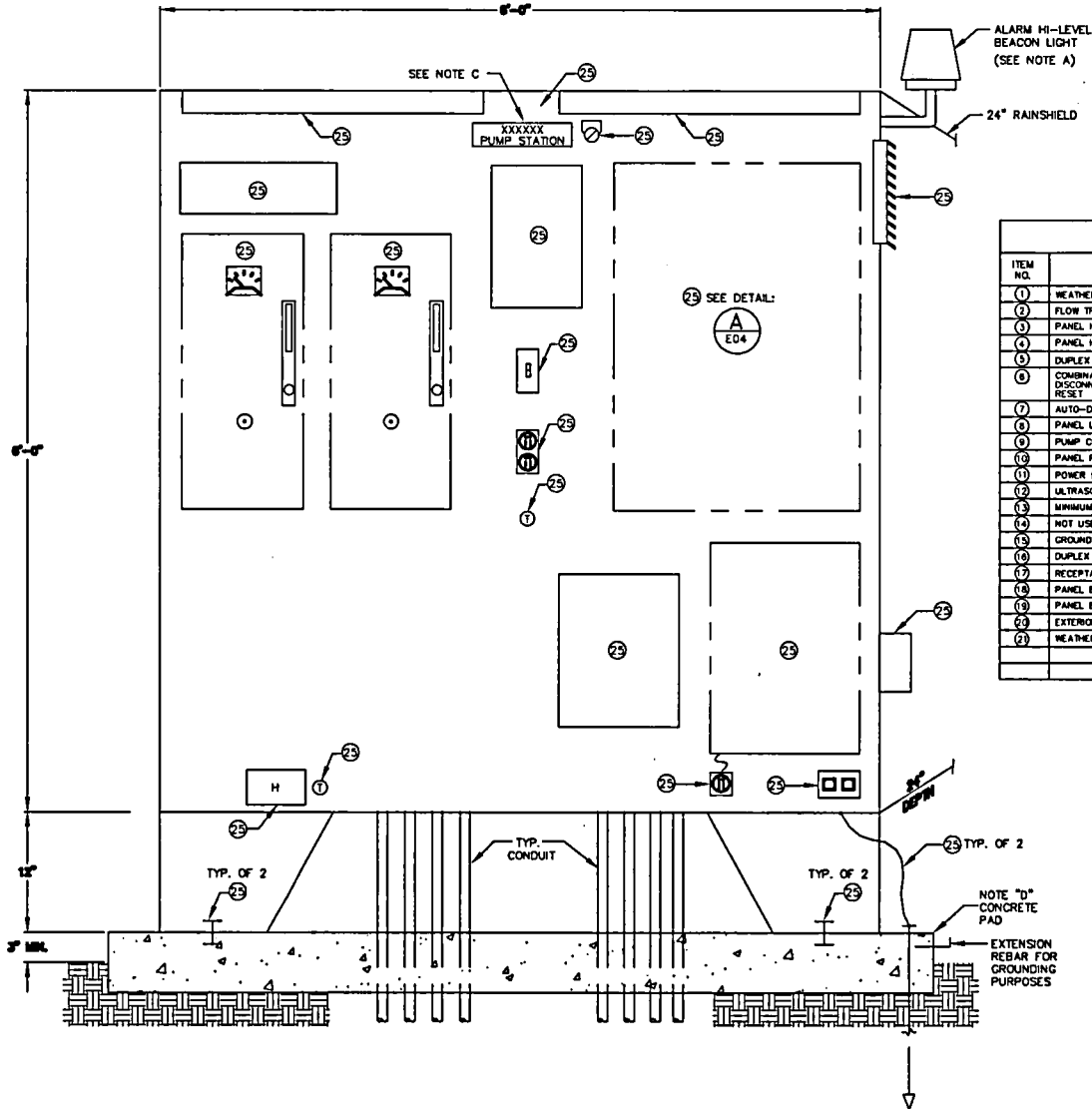
KEY NOTES:			LEGEND:
ITEM	DESCRIPTIONS	COMMENTS	
1	UTILITY XMFR POWER	480V, 3PHASE, 4W, 60HZ UNDERGROUND SECONDARY SERVICE	MTR MOTOR
2	METER ENCLOSURE	PER UTILITY STANDARDS	SL SEAL LEAK
3	MAIN SERVICE BREAKER	SUITABLE FOR SERVICE ENTRANCE	TS MOTOR OVER TEMP SWITCH
4	AUTOMATIC TRANSFER SWITCH		MCP MOTOR CIRCUIT PROTECTOR
5	STANDBY GENERATOR	PROVIDED WITH IN-LINE BREAKER	
6	POWER DISTRIBUTION BLOCK	480V, 3PHASE	
7	COMBINATION MOTOR STARTER PANEL	PROVIDED WITH AMMETER	
8	DRY TYPE XMFR PRIMARY BREAKER		
9	DRY TYPE XMFR	MIN 3 KVA, 480V-120/240V, 1PH	
10	LOAD CENTER	MIN 100AMPS, 120/240V, 1PH, 3W, 12 POLES	
11	DISCONNECT AIR GAP J-BOX	AIR GAP JUNCTION BOX CONFIGURATION	
12	UNDERGROUND CABLE TRENCH		
13	3-PHASE SECONDARY SURGE ARRESTOR		
14	PUMP SUBMERSIBLE MOTOR	MOTOR PROVIDED WITH MOTOR OVER TEMP AND SEAL LEAK	
15	PUMP SUBMERSIBLE POWER AND CONTROL CABLES	SUPPLIED BY PUMP MFR	
16	PUMP POWER WIRES	PROVIDE IN CONDUITS	
17	PUMP CONTROL WIRES	PROVIDE IN CONDUITS	
18	ULTRASONIC	CABLE BY MFR, NO SPLICE	
19	PUMP CONTROL PANEL		
20	FLOATS	OVER FLOW AND HIGH LEVEL	
21	FLOAT CONTROL WIRES		

DRAWING NO. 1072

ELECTRICAL
INTERIOR ENCLOSURE-01

REVISED 12-03

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KEYED NOTES & COMMENTS:		
ITEM NO.	DEVICE	COMMENTS
(1)	WEATHER PROOF ENCLOSURE	
(2)	FLOW TRANSMITTER	
(3)	PANEL HEATER	
(4)	PANEL HEATER THERMOSTAT	
(5)	DUPLEX TELEPHONE JACK	RADNO SHACK # 279-448
(6)	COMBINATION MOTOR STARTER, LOCKABLE DISCONNECT, AMMETER AND OVERLOAD RESET	
(7)	AUTO-DIALER	PROVIDED WITH POWER CORD
(8)	PANEL LIGHT ON/OFF	SWITCH ACTIVATED BY DOOR OPENING
(9)	PUMP CONTROL PANEL	
(10)	PANEL FLUORESCENT LIGHTS	
(11)	POWER DISTRIBUTION BLOCK	
(12)	ULTRASONIC CONTROLLER	
(13)	MINIMUM 1/2" ANCHOR BOLTS	STAINLESS STEEL
(14)	NOT USED	
(15)	GROUND RODS & GROUND WIRE, #1	
(16)	DUPLEX RECEPTACLE	
(17)	RECEPTACLE FOR AUTO-DIALER	
(18)	PANEL EXHAUST FAN WITH FILTER	
(19)	PANEL EXHAUST THERMOSTAT	
(20)	EXTERIOR POLE LIGHT SWITCH	
(21)	WEATHERPROOF DUPLEX OUTLET	

GENERAL NOTES

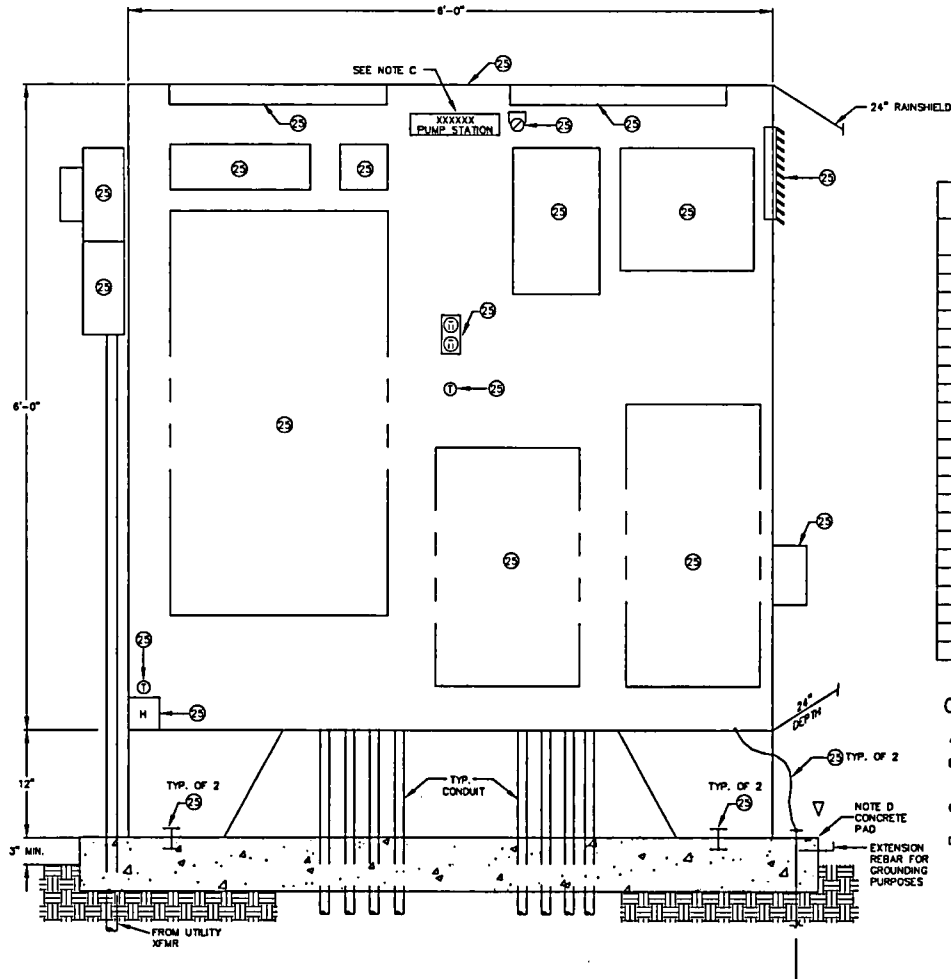
- A HIGH LEVEL ALARM, EXTERIOR BEACON LIGHT MOUNTED ON TOP OF PANEL. MUST BE SEEN FROM STREET LEVEL. FIELD ADJUST HEIGHT AS REQUIRED.
- B INTERIOR RACEWAY ROUTING BETWEEN PANELS WITHIN ENCLOSURES SHALL BE WELL COORDINATED AND SHALL BE RGS TYPE.
- C PROVIDE DESIGNATED PUMPSTATION NAMEPLATE OUTSIDE ENCLOSURE I.e. XXXX PUMPSTATION.
- D PAD DETAILS AND CONNECTION TO PAD SHOULD BE DESIGNED TO RESIST SEISMIC AND WIND LOADS. THE DETAILS SHOWN SHOULD BE CONSIDERED MINIMUMS.

DRAWING NO. 1073

ELECTRICAL
INTERIOR ENCLOSURE--02

REVISED 12-03

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KEYED NOTES & NAMEPLATE DESIGNATIONS:		
ITEM NO.	DEVICE	NAMEPLATE
(1)	WEATHER PROOF ENCLOSURE	PUMP STATION XXXX
(2)	LOAD CENTER	LOAD CENTER
(3)	PANEL HEATER	
(4)	PANEL HEATER THERMOSTAT	
(5)	3-PHASE SECONDARY SURGE ARRESTOR	SURGE ARRESTOR
(6)	DRY TYPE XMFR PRIM BREAKER	DRY TYPE XMFR PRIM BREAKER
(7)	DRY TYPE XMFR	
(8)	O & M RACK	O & M RACK
(9)	DUPLEX RECEPTACLE	CIRCUIT XX
(10)	PANEL FLOURESCENT LIGHTS	
(11)	POWER DISTRIBUTION BLOCK	
(12)	AUTOMATIC TRANSFER SWITCH	AUTOMATIC TRANSFER SWITCH
(13)	WEATHERPROOF DUPLEX OUTLET	CIRCUIT XX
(14)	PANEL LIGHT ON/OFF	ACTIVATED BY DOOR OPENING
(15)	GROUND RODS & GROUND WIRE, #1	
(16)	NOT USED	
(17)	NOT USED	
(18)	PANEL EXHAUST FAN w/FILTER	
(19)	PANEL EXHAUST THERMOSTAT	
(20)	MINIMUM 1/2" ANCHOR BOLT	
(21)	"METER-MAN" POWER METER BASE PER PGE STANDARDS	
(22)		

GENERAL NOTES:

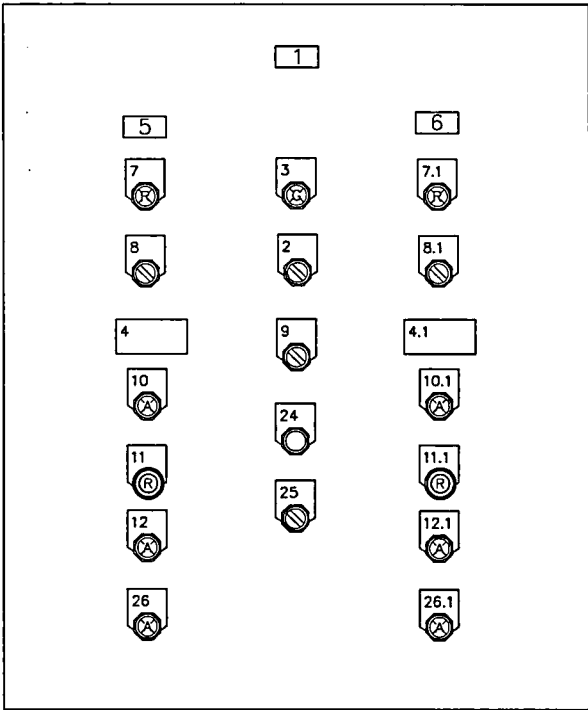
- A NOT USED
- B INTERIOR RACEWAY ROUTING BETWEEN PANELS WITHIN ENCLOSURES SHALL BE WELL COORDINATED AND SHALL BE RGS TYPE.
- C PROVIDE DESIGNATED PUMP STATION NAMEPLATE OUTSIDE ENCLOSURE I.e. XXXX PUMP STATION.
- D PAD DETAILS AND CONNECTION TO PAD SHOULD BE DESIGNED TO RESIST SEISMIC AND WIND LOADS. THE DETAILS SHOWN SHOULD BE CONSIDERED MINIMUMS.

1 ELECTRICAL ENCLOSURE - 02
SCALE: 3/4"=1'-0" (SEE NOTE 3)

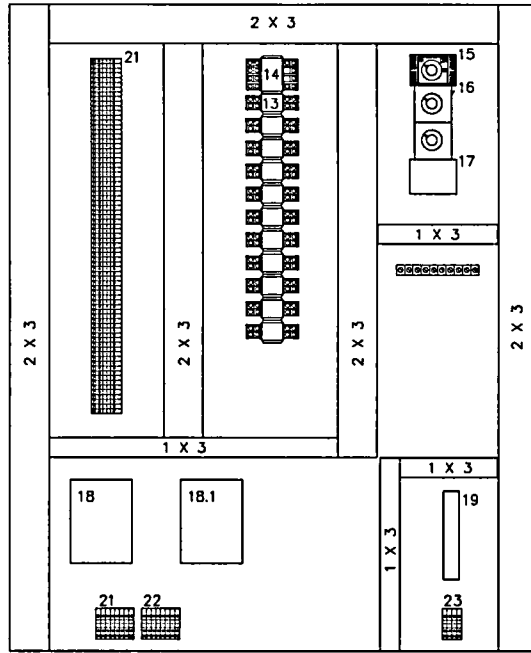
ELECTRICAL CONTROL PANEL DETAIL

DRAWING NO. 1074

REVISED 12-03



36"x30"x8"
ENCLOSURE

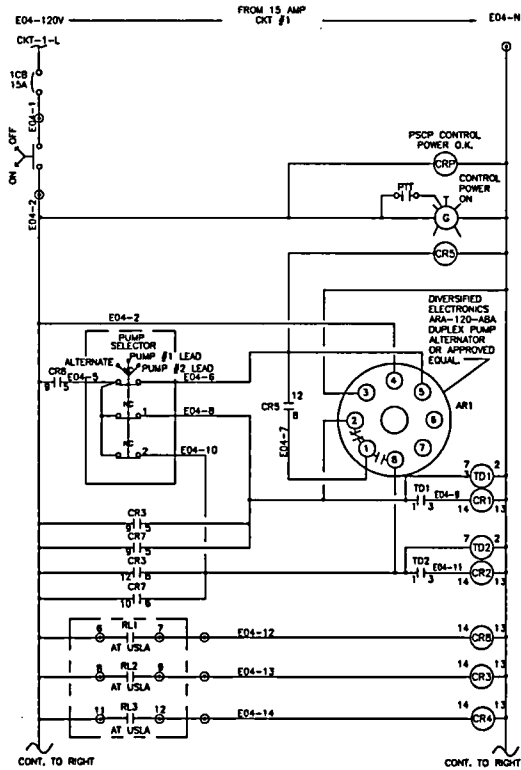


33"x27"
BACKPANEL

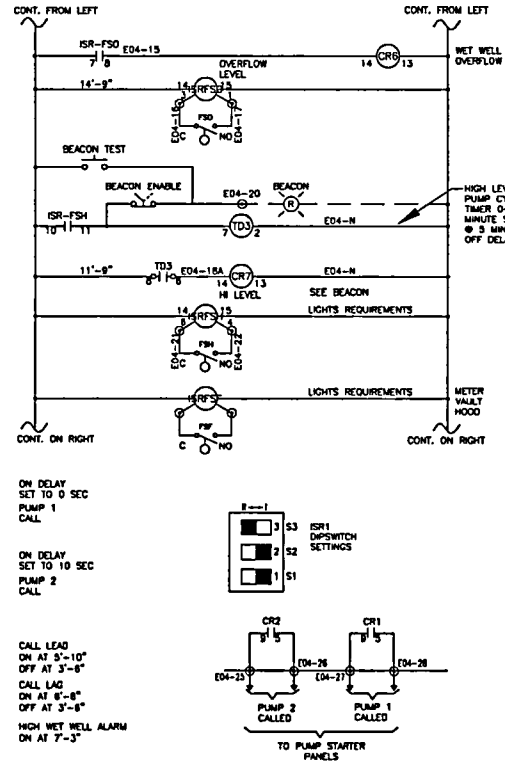
A PUMP SEQUENCE CONTROL PANEL (PSPC) -- FRONT DETAIL
SCALE: NTS SEE SHEET E02

ITEM NO.	DEVICE	NAMEPLATE
1	PUMP SEQUENCE CONTROL PANEL	PUMP CONTROL PANEL
2	SELECTOR SWITCH	CONTROL POWER ON/OFF
3	OVER LIGHT	CONTROL POWER ON
4	RAIN TIME METER	-
5	-	PUMP 1
6	-	PUMP 2
7	RED LIGHT	Running
8	SELECTOR SWITCH	A-B-A
9	ALTERNATOR SELECTOR SWITCH	LEAD SELECTOR PUMP-ALT-PUMPS
10	AMBER LIGHT	SEAL LEAK
11	RESET PUSHBUTTON	OVER TEMP RESET
12	AMBER LIGHT	MOTOR OVER TEMP
13	RELAY, 2 POLE	
14	RELAY, 4 POLE	
15	TIME, OFF DELAY	
16	TIME, ON DELAY	
17	ALTERNATING RELAY	
18	SEAL LEAK DETECTOR	
19	INTRINSICALLY SAFE RELAYS	
20	FLOAT SWITCHES, NO	
21	TERMINALS, PUMP WEG OF WIRING	
22	TERMINALS, SEAL LEAK 2 INCH/TEMP WIRING	
23	TERMINALS, INTRINSICALLY SAFE WIRING	
24	PUSHBUTTON, 1 N.O., 1 N.C.	HIGH LEVEL ALARM TEST
25	SELECTOR SWITCH, 2 POS, 1 N.O., 1 N.C.	HIGH LEVEL BEACON ALARM ENABLE-DISABLE
26	AMBER LIGHT	PUMP FAIL (OVERLOAD)

ELECTRICAL
SEQUENCE CONTROL DIAGRAM



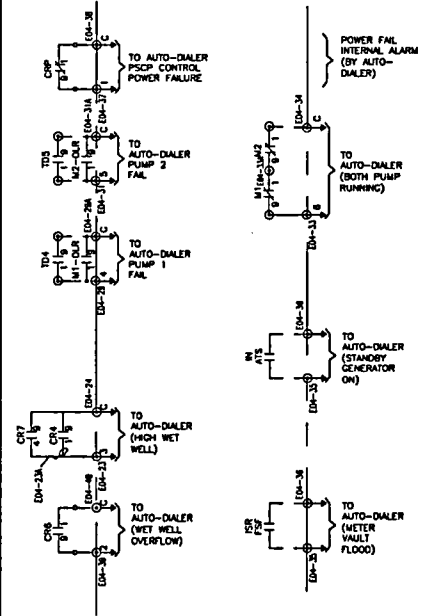
1 PUMP SEQUENCE CONTROL PANEL - CONTROL DIAGRAM (PSCP)
SCALE: NTS



2 AUTO-DIALER INPUT
SCALE: NTS

KEYED NOTES:

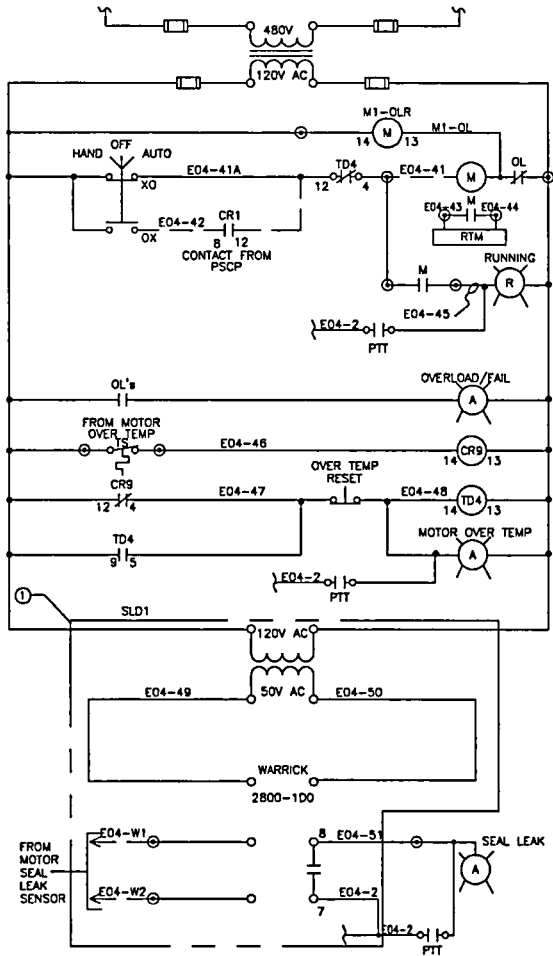
1 THIS IS REPRESENTATIVE OF PUMP TECH-WARRICK PUMP MONITOR UNIT FOR MOTOR SEAL LEAK DETECTION. CONTRACTOR IS RESPONSIBLE FOR INSTALLING THE UNIT PER THE PUMP MANUFACTURER'S RECOMMENDATIONS, AND TO PROVIDE ACCESSORIES AND CONNECTIONS TO PLACE THE ACTUAL PUMP FURNISHED INTO FULL OPERATION WITH LEAK PROTECTION. FIELD INSTALL UNIT IN STARTER PANEL.



DRAWING NO. 1076

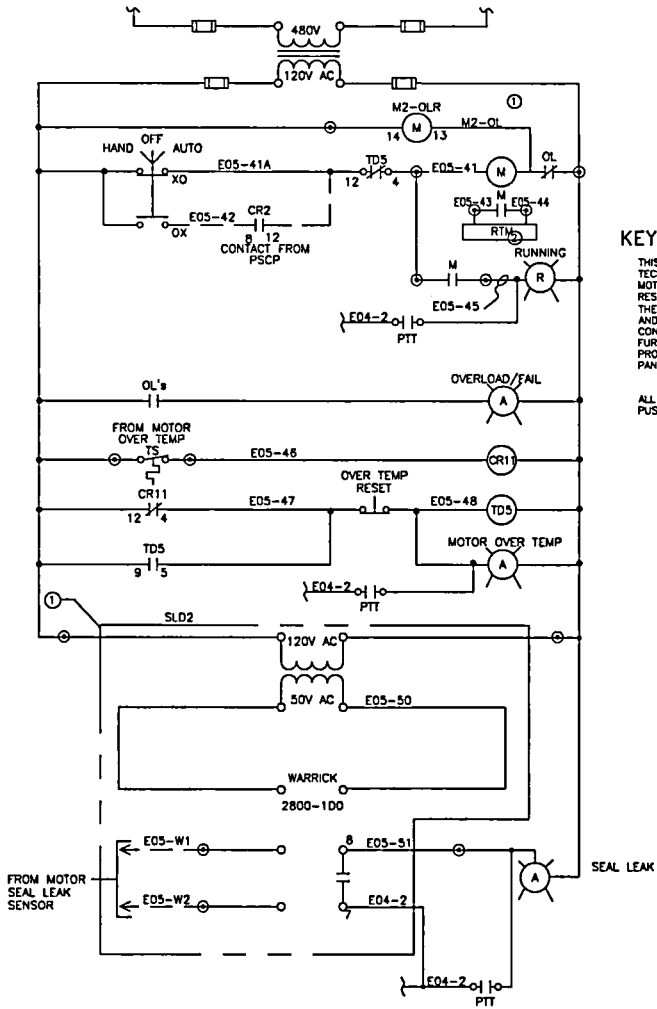
ELECTRICAL
PUMP CONTROL DIAGRAMS

REVISED 12-03



CONTROL DIAGRAM MOTOR STARTER
SUBMERSIBLE PUMP #1

SCALE: NTS



CONTROL DIAGRAM MOTOR STARTER
SUBMERSIBLE PUMP #2

SCALE: NTS

KEYED NOTES:

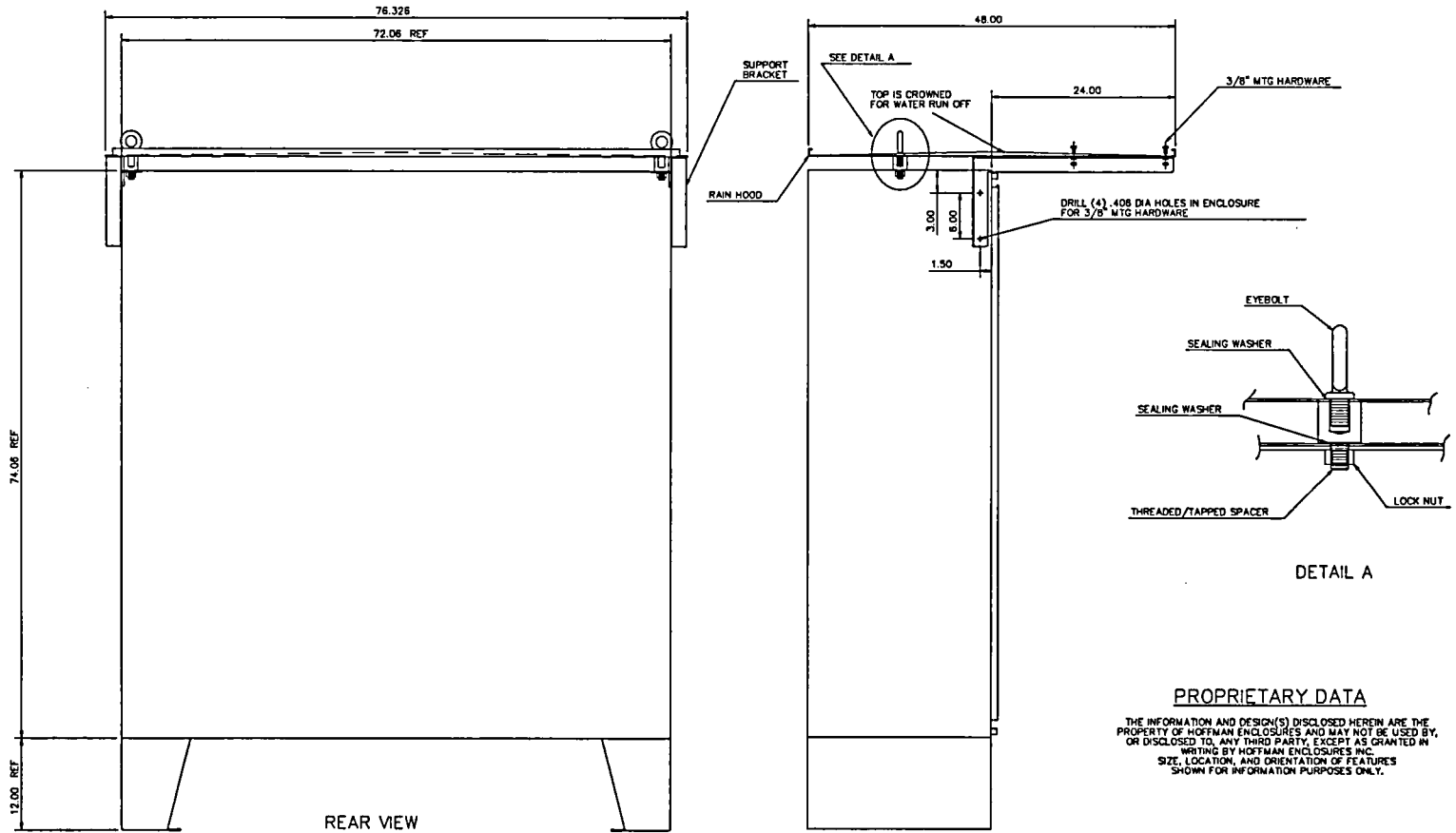
THIS IS REPRESENTATIVE OF PUMP
TEDI-WARRICK PUMP MONITOR UNIT FOR
MOTOR SEAL LEAK DETECTION. CONTRACTOR IS
RESPONSIBLE FOR INSTALLING THE UNIT PER
THE PUMP MANUFACTURER'S RECOMMENDATIONS,
AND TO PROVIDE ACCESSORIES AND
CONNECTIONS TO PLACE THE ACTUAL PUMP
FURNISHED INTO FULL OPERATION WITH LEAK
PROTECTION. FIELD INSTALL UNIT IN STARTER
PANEL.

ALL INDICATING PILOT LIGHTS SHALL BE
PUSH-TO-TEST AND LED LAMP TYPE.

ELECTRICAL
ENCLOSURE RAINSHIELD
DETAIL REFERENCE

DRAWING NO. 1077

REVISED 12-03



REAR VIEW

DETAIL A

NOTES:

1. ENCLOSURE TO BE A HOFFMAN CUSTOM NEMA 3R A727224USSLSPC ENCLOSURE WITH CUSTOM RAINHOOD AND CUSTOM L30 PADLOCKING HANDLE, SUPPORT BRACKETS, SPACERS & MTG HARDWARE.
2. DOORS NOT SHOWN.

PROPRIETARY DATA

THE INFORMATION AND DESIGN(S) DISCLOSED HEREIN ARE THE PROPERTY OF HOFFMAN ENCLOSURES AND MAY NOT BE USED BY, OR DISCLOSED TO, ANY THIRD PARTY, EXCEPT AS GRANTED IN WRITING BY HOFFMAN ENCLOSURES INC. SIZE, LOCATION, AND ORIENTATION OF FEATURES SHOWN FOR INFORMATION PURPOSES ONLY.

DRAWING NO. 1078

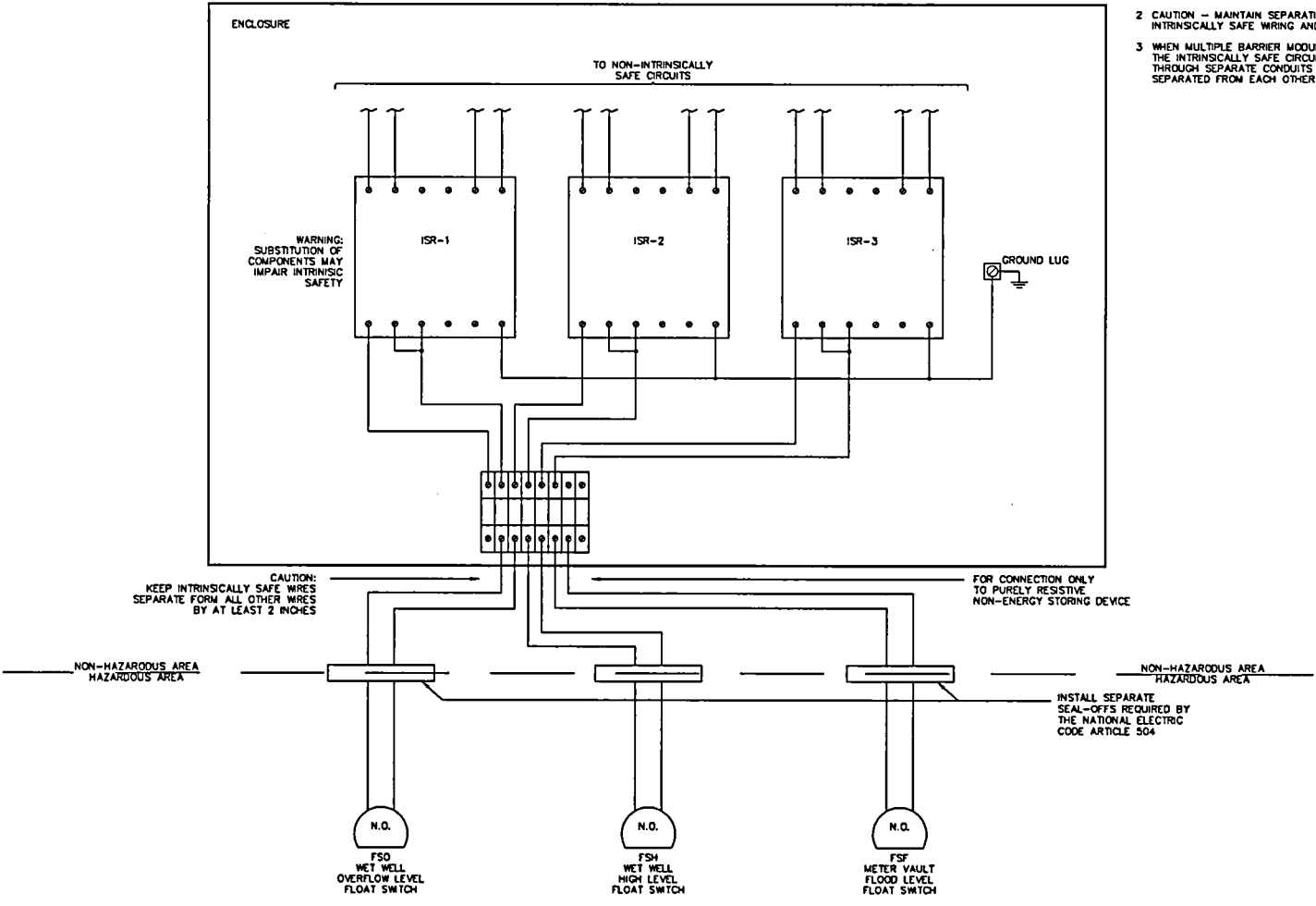
REVISED 12-03

ELECTRICAL
INTRINSICALLY SAFE
EXAMPLE DRAWING

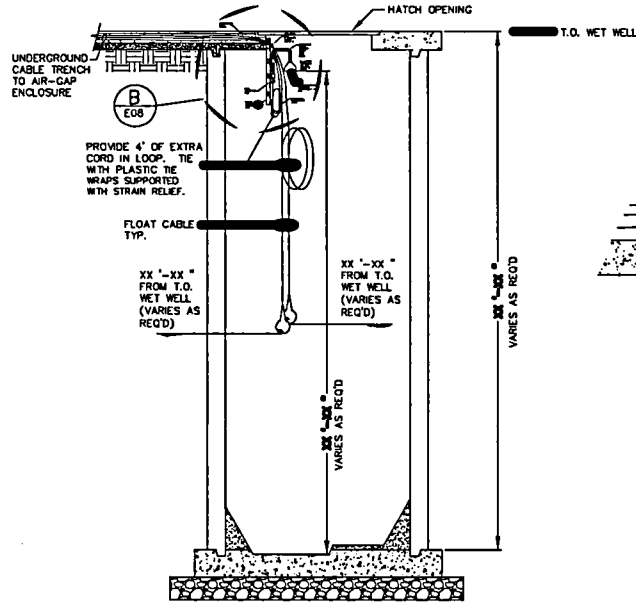


CAUTION
THIS CONTROL PANEL IS DESIGNED TO BE MOUNTED
IN A NON-EXPLOSIVE ENVIRONMENT. INSTALL PROPER
CONDUIT RUNS AND SEALING FITTINGS BETWEEN EXPLOSIVE
AND NON-EXPLOSIVE ENVIRONMENTS PER NATIONAL ELECTRIC CODES

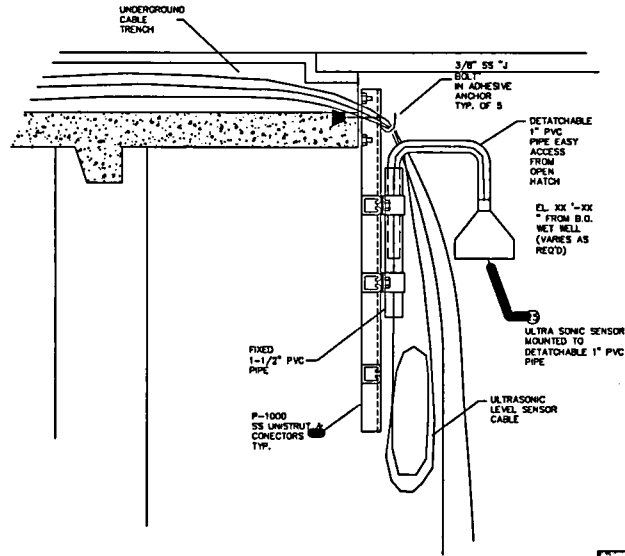
- NOTES:
- 1 CABINET TO BE CONNECTED TO A GOOD GROUND
 - 2 CAUTION - MAINTAIN SEPARATION BETWEEN INTRINSICALLY SAFE WIRING AND OTHER WIRING
 - 3 WHEN MULTIPLE BARRIER MODULES ARE USED THE INTRINSICALLY SAFE CIRCUITS MUST EXIT THROUGH SEPARATE CONDUITS AND BE SEPARATED FROM EACH OTHER



ELECTRICAL
WETWELL LEVEL DETAIL



A WETWELL LEVEL DETAIL
SCALE: 1/2"=1'-0"



B SENSOR MOUNTING DETAIL
SCALE: 3"=1'-0"

KEYED NOTES:

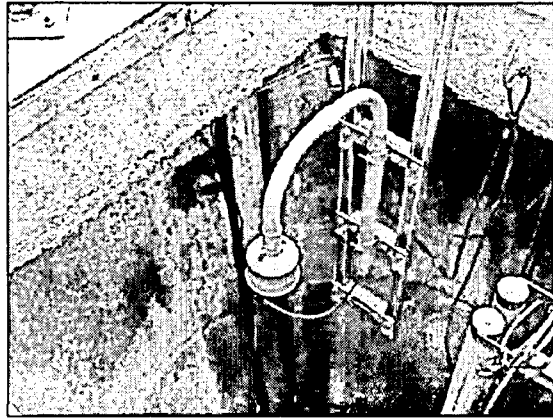
- ① INSTALL ULTRASONIC SENSOR THAT CAN BE ACCESSIBLE AND REMOVABLE FROM THE WETWELL ACCESS HATCH.

REFERENCE:

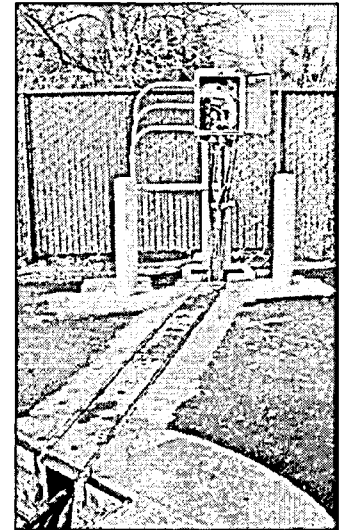
PUMP LEVEL OPERATING RANGE MUST BE PROGRAMMED IN ULTRASONIC TRANSMITTER (FROM BOTTOM OF WETWELL).

- LAG PUMP OFF: XX'-XX"
- LAG PUMP ON: XX'-XX"
- HI LEVEL ALARM: XX'-XX"

(FILL IN PUMP OPERATION ELEVATIONS AS REQ'D.)



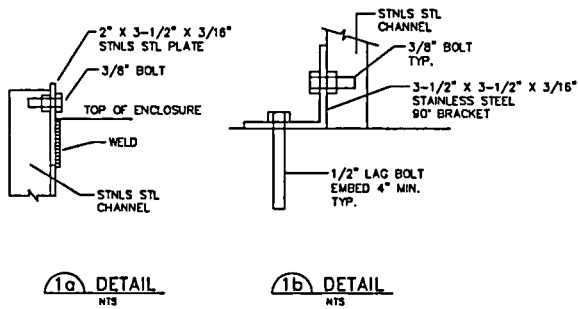
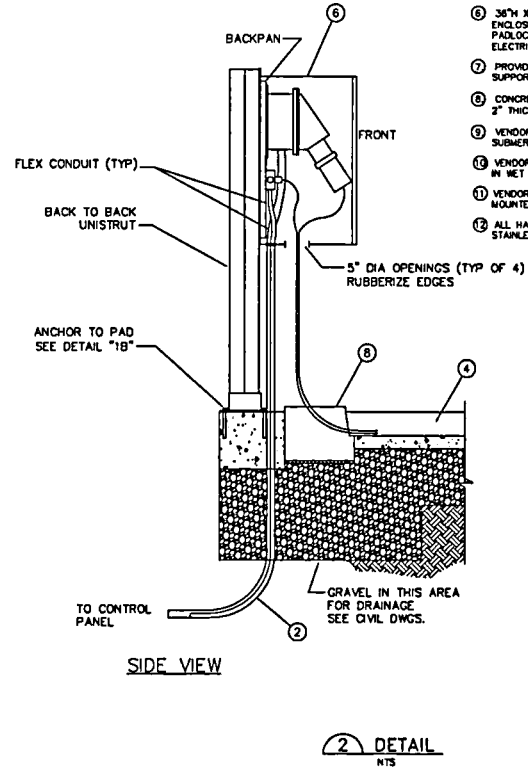
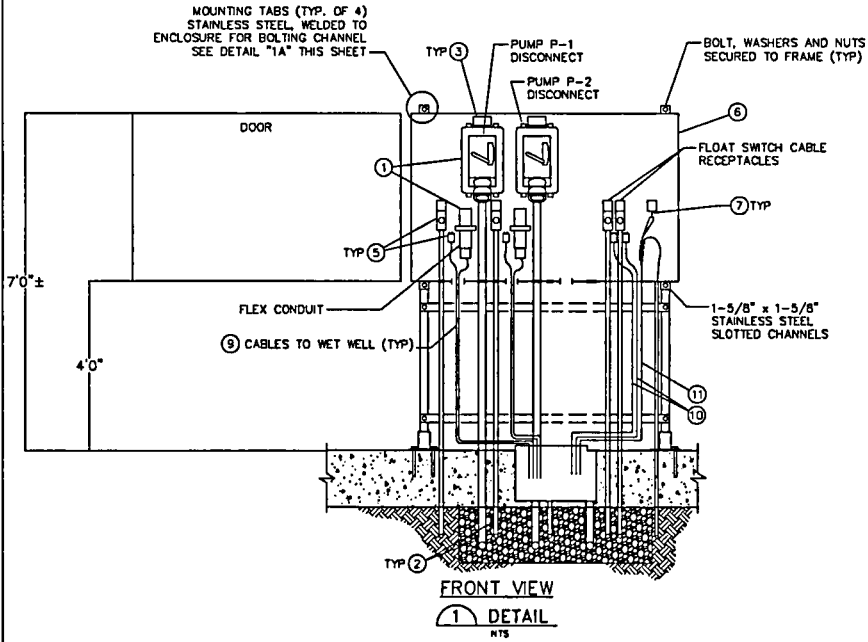
C MOUNTED SENSOR
NTS



D CABLE TRENCH
NTS

KEYED NOTES:

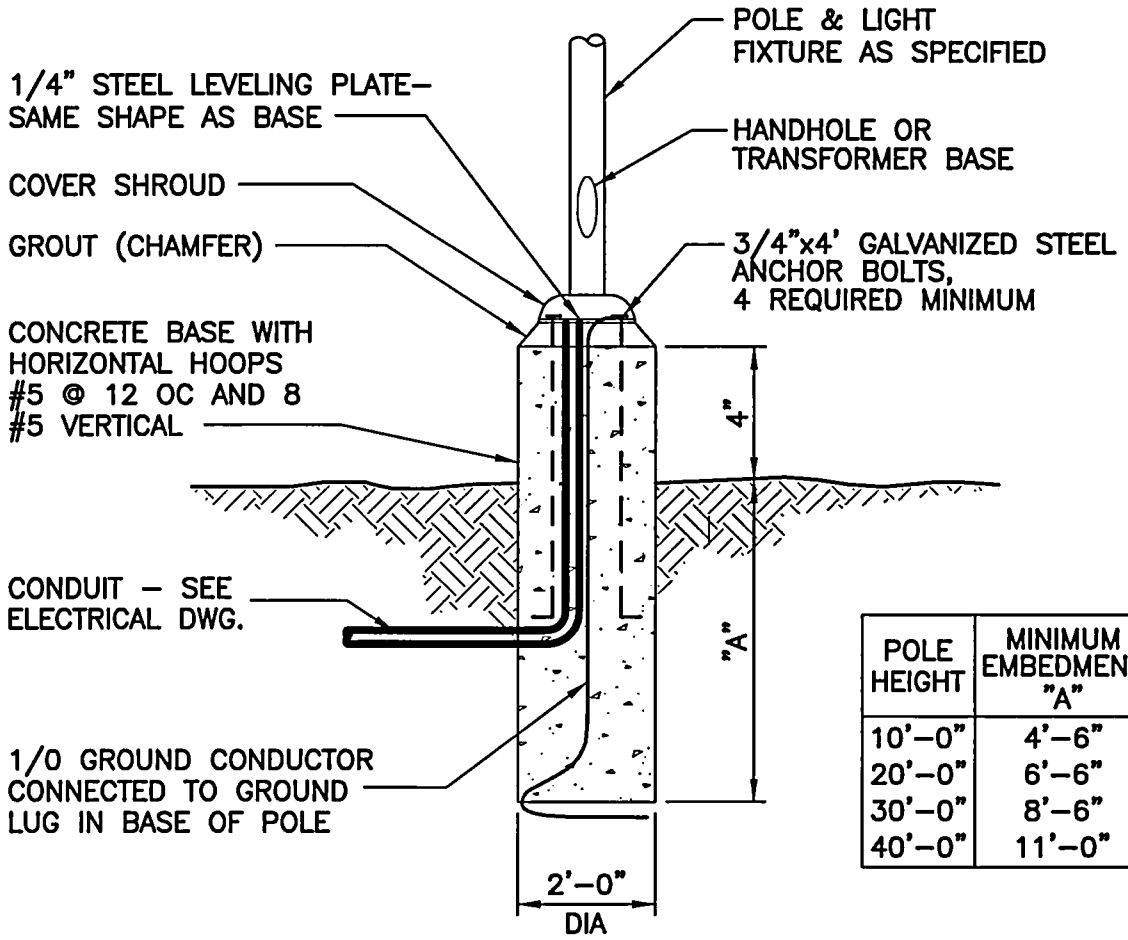
- ① PIN & SLEEVE INTERLOCK. 480V, 3P, 4W. HUBBELL WITH MATCHING PLUG. (2 REQ'D)
- ② CONDUITS TO STARTERS AND PUMP SEQUENCE CONTROL PANEL. NOTE POWER AND CONTROL CONDUCTORS IN SEPARATE CONDUITS. ROUTE CONDUITS DOWN INTO GROUND.
- ③ INSTALL EQUIPMENT NAME PLATES ABOVE EACH SWITCH AND RECEPTACLE.
- ④ CABLE CHANNEL TO WET WELL. SYNERTECH MOULDED PRODUCTS MODEL NO. 88 PLASTIBETON CHANNEL SYSTEM COMPLETE WITH COVER AND SMC DIVIDER TO PARTITION POWER CABLES FROM INSTRUMENTATION CABLES. SEE CIVIL DWGS.
- ⑤ PROVIDE 3P, 4W, 20A, 125V SINGLE LOCKING RECEPTACLE IN CAST OUTLET BOX WITH WEATHERPROOF COVER. PROVIDE MATCHING PLUG. ARROW-HART #400 AND #402 OR EQUAL.
- ⑥ 36" X 36" X 24" (MIN.) NEMA 3R STAINLESS ENCLOSURE WITH TWO (2) QUARTER TURN PADLOCKABLE HANDLES ENCLOSURE BY FOUCH ELECTRIC MFG. CO., (503) 284-1413.
- ⑦ PROVIDE J-HOOKS & KELLUMS GRIPS TO SUPPORT ALL FLEXIBLE CORDS.
- ⑧ CONCRETE HANDHOLE. 30" X 24" X 24". 2" THICK, MIN., WITH REINFORCING WIRE MESH.
- ⑨ VENDOR CABLES (POWER AND CONTROL) TO SUBMERSIBLE PUMPS LOCATED IN WET WELL.
- ⑩ VENDOR CABLES TO FLOAT SWITCHES MOUNTED IN WET WELL.
- ⑪ VENDOR CABLES TO ULTRASONIC LEVEL TRANSDUCER MOUNTED IN WET WELL.
- ⑫ ALL HARDWARE, FRAMEWORK, ETC. SHALL BE STAINLESS STEEL.



DRAWING NO. 1080

**ELECTRICAL
DISCONNECT AIR-GAP
JUNCTION BOX DETAILS**

REVISED 12-03



POLE HEIGHT	MINIMUM EMBEDMENT "A"
10'-0"	4'-6"
20'-0"	6'-6"
30'-0"	8'-6"
40'-0"	11'-0"

TYPICAL LIGHT POLE BASE

ELECTRICAL
LIGHT POLE DETAIL

DRAWING NO. 1081

REVISED 12-03



STAFF REPORT

IN CONSIDERATION OF RESOLUTION NO. 05-3577 APPROVING THE TUALATIN BASIN NATURAL RESOURCES COORDINATING COMMITTEE'S FISH AND WILDLIFE HABITAT PROTECTION PROGRAM.

Date: April 14, 2005

Prepared by: Andy Cotugno and Chris Deffebach

CONTEXT AND BACKGROUND

In January 2002 Metro entered into an intergovernmental agreement ("IGA") with local governments and special districts in the Tualatin Basin (called the Tualatin Basin Natural Resources Coordinating Committee, TBNRCC) setting forth a cooperative planning process to address regional fish and wildlife habitat within the basin. The IGA provided that the Tualatin Basin partners would submit their program and analysis to Metro for review and, if it met standards for habitat protection described in the IGA, then Metro would include it as part of the regional habitat protection program. Approximately 16,650 acres of Metro's total habitat inventory of 80,000 acres are located within the jurisdiction of the local governments participating in the Tualatin Basin partnership. The regional fish and wildlife habitat protection program is part of Metro's Nature in Neighborhoods initiative (Resolution No. 05-3574).

The IGA describes the goals the TBNRCC must strive to achieve in the Tualatin Basin. The overriding goal of the Basin Approach is taken from Metro's Streamside CPR Program Outline "Vision Statement", which states:

The overall goal is to conserve, protect and restore a continuous ecologically viable streamside corridor system, from the stream's headwaters to their confluence with other streams and rivers, and with their floodplains in a manner that is integrated with the surrounding urban landscape. This system will be achieved through conservation, protection and appropriate restoration of streamside corridors through time.

In order to achieve this goal (and to further define the scope), the IGA also identified improvement in the environmental health of each of the eleven subwatersheds in the basin and of the entire Tualatin Basin as a primary objective.

Consistent with the terms of the IGA, the TBNRCC accepted Metro's regionally significant fish and wildlife habitat inventory and undertook its own separate Environmental, Social, Economic and Energy (ESEE) analysis. The TBNRCC reviewed the ESEE analysis and a draft protection program with the public and with Metro's technical and policy advisory review committees, as per the IGA.

On April 4, 2005, the TBNRCC approved the Tualatin Basin Goal 5 Program Report and forwarded it to the Metro Council for consideration as part of the regional habitat protection plan on April 7, 2005. Per the IGA, Metro Council has agreed to determine if the Tualatin Basin Program meets the overall habitat goals and take action on the Tualatin Basin Program within

120 days. Metro is scheduling public hearings to provide additional public comment opportunity and will review the proposal with Metro's technical and policy advisory committees.

Current Action

Resolution No. 05-3577 presents the staff recommendation on the Tualatin Basin Program for Metro Council consideration. The Metro Council may take one of the following approaches when considering this Resolution:

- Approve the Basin Program and include in the regional program;
- Disapprove the Basin Program; or
- Approve the Basin Program with conditions for inclusion in the regional program.

If Metro Council approves this Resolution, the Tualatin Basin Program will be included as one of the compliance alternatives for cities and counties participating in the TBNRCC in proposed Title 13 of the Urban Growth Management Function Plan and presented for additional public review and comment. Two other pieces of legislation related to nature in neighborhoods and fish and wildlife habitat are currently under Metro Council consideration that relate to this Resolution.

- Resolution No. 05-3547 describing Metro's Nature in Neighborhoods initiative is also available for public review. This resolution is schedule for final consideration on May 12, 2005.
- Title 13: Nature in Neighborhoods, and accompanying amendments to Metro's Urban Growth Management Functional Plan and Framework Plan are available now for public comment in Ordinance No. 05-1077. This ordinance is scheduled for final consideration in Fall 2005.

Final action on the Tualatin Basin Program will occur when Ordinance No. 05-1077, amending the Regional Framework Plan and the urban growth management functional plan relating to Nature in Neighborhoods, is adopted. If Metro Council approves this resolution for inclusion of the Tualatin Basin Program as part of the regional program, Metro would carry out the required public notice process. Upon final program adoption by Metro Council, the Tualatin Basin Program would be submitted to the Land Conservation and Development Commission (LCDC) along with the regional program for acknowledgement under Statewide Planning Goal 5. Finally, upon Metro Council adoption of the Basin Program and its acknowledgement by LCDC, the TBNRCC has agreed, per the IGA, to begin amending local comprehensive plans and land use regulations to complete implementation within one year of Metro's action.

SUMMARY OF TUALATIN BASIN PROGRAM AND COMPARISON WITH METRO'S PROPOSED PROGRAM

In December 2004, the Metro Council approved Resolution No. 04-3506A, which directed staff to develop a fish and wildlife habitat protection program to reflect the following principles:

- Focus the regulatory element on the most valuable Class I and II Riparian habitat. About 9,600 acres of Class I and II Riparian habitat are located within the Tualatin Basin (inside the jurisdiction of the TBNRCC and within Metro's boundary).
- Develop a strong voluntary, incentive-based approach to protect and restore all regionally significant habitat.
- Apply regulations to limit development in Class A and B upland habitat in future urban growth boundary expansion areas.

As described in Exhibit A to this Resolution, the Basin Program relies on two major elements for protection of regionally significant fish and wildlife habitat.

- Clean Water Services' (CWS) basin-wide updated Vegetated Corridor standards. This is the regulatory element of the program.
- CWS Healthy Streams Plan. This describes the non-regulatory element of the program.

A brief summary of the Basin Program and comparison with Metro's proposed regional program is included below.

A. Vegetated Corridor Standards

The Vegetated Corridor standards implement the regional Title 3 standards. They were recently updated and now regulate significantly more stream miles than required by Metro's Title 3 water quality standards. The development standards include a requirement to avoid, minimize, and mitigate within the Vegetated Corridor. There is also an enhancement requirement for the Vegetated Corridor even if a proposed development on a site does not intrude into the corridor. They include protection of headwater streams and along the Tualatin River. The Vegetated Corridor standards generally protect and enhance riparian vegetation within:

- 15 feet of flat headwater streams, including streams that drain 10 acres,
- from 15-200 feet in other headwater streams depending on steep slopes,
- within 50 feet of other streams, and
- within 125 feet of the Tualatin River.

For undeveloped floodplains outside of the Vegetated Corridor, balanced cut and fill is the only requirement. Balanced cut and fill addresses water storage issues to prevent floods from damaging other property, but does not address other habitat functions.

The Basin Program does not propose additional regulation of areas outside the existing Vegetated Corridors. Local Goal 5, floodplain, tree protection and other standards protect habitat at varying levels outside of the Vegetated Corridors. The Basin Program also proposes a model low impact development ordinance to be developed for consideration by jurisdictions to promote habitat-friendly, low impact development practices.

B. Healthy Streams Plan

The TBNRCC proposes using the Clean Water Services Healthy Streams Plan (HSP) to direct revenue and voluntary efforts to their list of watershed enhancement priorities. The Healthy Streams Plan, which is in draft form and has not yet been adopted, recommends \$95 million in capital improvements over the next 20 years, ranging from \$3.5-\$6.5 million per year. The plan focuses projects in areas of highest quality resources. Typical plan projects will include:

- community tree planting,
- riparian corridor restoration and enhancements,
- culvert replacements,
- storm water outfall retrofits, and
- flow restoration.

Some of the plan's project priorities lie outside of Metro's jurisdiction but would still improve overall watershed health. For example, a flow restoration project outside of Metro's jurisdiction can positively affect stream flow downstream, and restoration of headwaters outside the Metro jurisdiction can help to reduce stream temperature downstream. Exhibits to this Resolution include the current draft Healthy Streams Plan and a map of its recommended priority projects.

The Healthy Streams Plan will be implemented by Clean Water Services and is scheduled for its consideration in the next few months. The HSP was approved by the Healthy Streams Plan Advisory Committee, a technical committee comprised of staff from local jurisdictions and other agencies. The Basin Plan includes a proposal that the TBNRCC will recommend projects for implementation and CWS will make the final decision on which projects are chosen. The Healthy Streams Plan's restoration projects are guided by watershed assessment and a model developed by researchers at Oregon State University called the Restore model. The Restore model incorporates existing and anticipated conditions to identify priority restoration and enhancement projects designed to strategically enhance the Basin's watersheds.

Clean Water Services estimates that the surface water management (SWM) fees currently collected, together with existing funds, are expected to cover program costs for several years. However, CWS anticipates that a future SWM fee increase may be necessary to complete the 20-year plan. The CWS surface water management program is currently funded at a very modest level relative to similar jurisdictions throughout the region and the state. Clean Water Services recently conducted a public values survey in which over ninety percent of respondents were willing to support a modest fee increase of \$1 to \$2 per month. Based upon recent estimates, a \$1 per month per ESU (equivalent service unit) increase will generate more than \$63 million over twenty years. The Basin Program indicates that CWS will consider increases over time, as necessary to implement the Healthy Streams Plan.

All of the capital improvements identified in the HSP are projects designed to enhance riparian corridor conditions and/or improve stream health. These projects generate ongoing, cumulative benefits to water quality and aquatic habitat. The community tree planting projects will provide multiple benefits including water quality, in-stream, and near stream habitat improvements, as well as community education and awareness.

Other potential funding alternatives (including grants, local bond measures, opportunities for parks Systems Development Charges, etc.) may be utilized for education, restoration and enhancement or acquisition within the Basin.

C. Comparison of Basin Program and Metro's proposed program

As summarized above, the Basin Program relies on current Clean Water Services regulations that implement Metro's water quality and flood management requirements for regulatory protection of streamside habitat in the Tualatin Basin. However, the Basin Program includes a strong voluntary, incentive-based restoration and enhancement component that is based on a reliable funding source – surface water management fees. Comparisons between the Basin Program and the regional program being recommended by Metro staff, which is still subject to review and amendment by the Metro Council, are described below.

Regulatory Protection

Both Metro and the TBNRCC have attempted to quantify the difference in regulated area between the Basin Program and the Metro program recommended by staff in Ordinance No. 05-1077. Since CWS does not map the Vegetated Corridor boundaries, an easy, direct comparison between the areas covered by CWS standards and those that may be covered by Metro's standards is not possible. One proxy developed by Washington County staff estimated that 65% to 75% of Metro Class I and II riparian habitat in the basin is located within areas subject to either CWS Vegetated Standards or its balanced cut and fill requirements.

Metro staff has made the following estimates of the amount of Metro's Class I and II riparian habitat in the Tualatin Basin that would be covered by Metro's Title 3 requirements, as adopted by Metro in 1998:

- ***Water Quality Resource Area (WQRA)***: 3,850 acres covered, or 40% of Metro's Class I and II riparian habitat;
- ***Flood Management Area (FMA)***: 2,020 additional acres covered, or 21% of Class I and II riparian habitat; and
- ***Outside Title 3***: 3,720 acres outside Metro's Title 3, or 39% of Class I and II riparian habitat.

It should be noted, however, that CWS Vegetated Corridor standards apply to more streams than required by Title 3. For example, the Vegetated Corridor standards apply to headwater streams and additional stream miles added to the CWS stream database. Thus, although neither of these approaches is perfect, Metro staff believes that it is reasonable to conclude that the Vegetated Corridor standards apply to approximately 65% to 75% of Metro's Class I and II riparian habitat in the basin.

Metro staff's proposed program would apply the avoid-minimize-mitigate standard to all Class I and II riparian habitat. In the Tualatin Basin, a substantial portion of the Class I habitat is within the Vegetated Corridor, and subject to the same avoid-minimize-mitigate standard. However, less of the Class II habitat would fall within the Vegetated Corridor, since much of it is further

from streams. Any Class I or II riparian habitat outside of the Vegetated Corridor would not be covered with regulatory protection.

Another difference is the level of protection for undeveloped floodplains. In Ordinance No. 05-1077 staff recommends that undeveloped floodplains be subject to the same avoid-minimize-mitigate standard that is applied by CWS in the Vegetated Corridor. The Basin Program relies on a balanced cut and fill requirement for these areas, unless modified by local floodplain regulations, which have been adopted by some of the local jurisdictions in the basin.

Voluntary, Incentive-based Program

It is difficult to compare and contrast the voluntary component of the Basin Program with the program proposed by Metro staff. The program proposed by staff in Ordinance No. 05-1077 encourages cities and counties to develop a voluntary component to accomplish protection, restoration and enhancement. Metro's Council President has proposed consolidating and re-directing resources for habitat protection, restoration, and open spaces into a Nature in Neighborhoods initiative (Resolution No. 05-3574), which would include a regional bond measure for fish and wildlife habitat acquisition and restoration in November 2006.

The Basin Program contains a strong voluntary, incentive-based component that is founded on an existing funding source with the potential to raise additional dollars over time. However, there is no guarantee built into the Basin Program as written that the TBNRCC will commit to renew and extend its partnership to implement the projects described in the Healthy Streams Plan.

D. Implementation Plan for Basin Program

If Metro approves the Tualatin Basin Program and incorporates it into Title 13 of the Functional Plan, Chapter 7 of the Tualatin Basin Program: Program Implementation, Administration and Monitoring describes the general steps anticipated for implementation. They are:

1. Development and adoption of local ordinances implementing the provisions of the Basin Program, as incorporated in Metro's program and holding additional public notice and hearings as appropriate.
2. Development of a model low impact development ordinance for the basin, including local adoption of LID guidelines.
3. Coordination with CWS for activities necessary for implementation of the Healthy Streams Action Plan as well as for local actions needed to support the updated Stormwater Management Plan.
4. Coordination with Metro on development of a regional bond measure supporting protection of regionally significant fish and wildlife habitat.
5. Coordination with CWS, Metro and others as necessary to develop and support the voluntary and educational components of the Basin Program.
6. Coordination with CWS, Metro and others as necessary to develop and support that monitoring and adaptive management components of the Basin Program.

E. Summary and Conditions for Approval

The Tualatin Basin Program is similar in some ways to the staff recommendations in Ordinance No. 05-1077. The IGA does not require the Tualatin Basin Program to be the same as the regional program, but to achieve the same vision for ecological health. The staff analysis concludes that the Basin Program generally has the potential to improve regionally significant habitat conditions basin-wide and within each of the basin's subwatersheds, and that it substantially complies with the "overall goal" of the Vision Statement with a few exceptions as described in this Resolution. These exceptions relate to:

- Uncertainty of commitment to the Healthy Streams Plan;
- The need to continue to coordinate in the Nature in Neighborhood Initiative;
- Potential loss of habitat in Class I and II Riparian Habitat outside of Vegetated Corridors and especially in undeveloped floodplains;
- Use of habitat-friendly development practices in all Class I and II riparian habitat areas;
- Consistency with other cities and counties on implementing the program relating to lower minimum densities for habitat protection, monitoring and reporting; and
- Application of the program in upland wildlife habitat in future UGB expansion areas.

Based on these points, staff recommends conditions of approval relating to:

- 1. Commitment to implement the Healthy streams plan.** Staff recommends that the TBNRCC demonstrate commitment to the Healthy Streams Plan by requiring CWS to approve the plan. In addition, staff recommends that the TBNRCC members agree to renew and extend their partnership to implement the projects on the Healthy Streams Project List.
- 2. Metro Coordination.** In addition to the implementation points included in the Basin Program staff recommend that the TBNRCC agree to continue to coordinate its activities with Metro and cooperate with Metro on the development of regional public information about the Nature in Neighborhoods initiative.
- 3. Target projects for protection of the Class I and II Riparian areas outside of the vegetated corridors.** According to one estimate, the CWS Vegetated Corridor Standards covers only approximately 65% to 75% of the Class I and II Riparian areas, and includes substantively less restrictive regulations for protection of habitat values in undeveloped floodplains than those proposed by staff in Ordinance No. 05-1077. This leaves approximately 25% to 35% for protection through capital projects in the Healthy Streams Plan, voluntary adoption of low impact development standards, and protection through existing local programs. Due to the importance of protecting habitat in Class I and II Riparian areas for achieving the overall goal for the Basin, staff recommends that the TBNRCC place the highest priority on HSP projects that protect and restore Class I and II Riparian Habitat, including habitat that extends beyond the Vegetated Corridors.
- 4. Habitat-Friendly Development Standards for all of Class I and II Riparian Areas.** In Ordinance No. 05-1077, staff recommends that the use of Habitat Friendly Development Practices in Class I and II Riparian areas be required by cities and counties

where technically feasible, and be encouraged elsewhere in the watershed. Staff recommends that the TBNRCC require the use of these practices in Class I and II Riparian areas to help minimize loss of habitat outside of the Vegetated Corridors.

5. **Lower density standards to protect habitat and ongoing monitoring and reporting.** The TBNRCC has proposed to use lower density standards as a tool to protect habitat and has proposed to participate with Metro in ongoing monitoring and reporting of conditions in the Basin. Staff recommends that the TBNRCC agree to use the same protocol for establishing protection of habitat when reducing density and for monitoring and reporting as the other cities and counties, as proposed in Ordinance No. 05-1077.
6. **New Urban Area Planning.** In December 2004, Metro Council clarified its intent to establish higher expectations for habitat protection in future new urban areas, including protection of both Riparian and Upland Habitat Areas. In response, staff propose that the cities and counties within the Tualatin Basin comply with Title 13 as it applies to upland wildlife habitat in future urban areas by either (1) adopting Metro's Title 13 Model Ordinance, (2) substantially complying with the performance standards and best management practices in Section 4 of Title 13, or (3) by developing alternative approach comparable to the results that would be achieved by following option (1) or (2).

ANALYSIS/INFORMATION

1. **Known Opposition.** The Audubon Society of Portland, Tualatin Riverkeepers and others have raised concerns with the Tualatin Basin Program. Other opposition is included in the public comment report submitted to Metro from the Tualatin Basin.
2. **Legal Antecedents.** This Resolution carries out the IGA between Metro and the TBNRCC.
3. **Anticipated Effects.** Approval of this resolution will allow Metro to incorporate the Basin Program approach as a package, with conditions if needed, and complete the three-step process for complying with Statewide Land Use Planning Goal 5 by amending portions of the Regional Framework Plan and Urban Growth Management Functional Plan. This allows Metro to submit a complete package, including the Tualatin Basin's program within Metro's regional program, to the Department of Land Conservation and Development for review. In addition, basin cities and counties have voluntarily committed, in the IGA, to implement the program within one year of Metro approval of the Basin program, which is sooner than Metro may require cities and counties to comply with new functional plan requirements.
4. **Budget Impacts.** Additional staff work and coordination resulting from Council's acceptance of the Basin program would be considered part of the ongoing implementation of Metro's Nature in the Neighborhoods initiative.

RECOMMENDED ACTION

Staff requests that Council approve this Resolution and direct staff to incorporate the Tualatin Basin Program into Ordinance No. 05-1077, amending the Regional Framework Plan and Urban Growth Management Functional Plan relating to the Nature in Neighborhoods initiative.